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Our Change in Name

Beginning with this issue the name of the *American Engineer* will be changed to *Railway Age Gazette, Mechanical Edition,* although the name *American Engineer* will accompany it, as shown on the title page. From a sentimental standpoint the necessity of making this change is to be regretted, for the name has made a warm place for itself in the hearts of many mechanical department officers. On the other hand, in this day of highly specialized technical journals, it is not only advisable, but almost necessary to use names that clearly define the fields which the various journals are designed to cover. The *American Engineer* was primarily intended to meet the needs of railway mechanical department officers and foremen, but the name did not imply this, and in many cases has been known to create a wrong impression. In seeking for a better name it seemed best to have the paper known as the mechanical edition of the *Railway Age Gazette,* which is so thoroughly well known in the railway field. The change is a change in name only—the editorial policy, the editorial staff, the grade of paper and printing, etc., will remain the same as before. We trust that the new name will meet with the approval of our readers.

Hot Boxes on Locomotives

A frequent cause of hot boxes on locomotives, and one which it is very difficult to avoid, is the running of the wheels through the piles of cinders which spread out over the rails after an ashpan has been cleaned while the locomotive is on the road. It is possible, however, that a considerable part of this trouble could be avoided by a systematic inspection of all the boxes of each locomotive at the engine houses, and it is quite certain that a great deal of the trouble which is caused by hot boxes could be eliminated by the inauguration of some such system. When it is considered that the possibilities of delays due to one hot box are almost unlimited, it is surprising that some system of periodical inspection and packing of boxes has not been installed on all railroads. In the majority of cases boxes are packed only when they are reported as having given trouble, or when the indicators on the hard grease boxes are so far up that it is evident that the box needs packing.

High Water and Superheaters

While there is always more or less difficulty in educating enginemen in the use of new devices, it would seem that the superheater had been in use a sufficient length of time on many roads for the men to have obtained a good general knowledge of the purpose for which it is intended; yet on some of the roads which have a large number of locomotives so equipped, there are still enginemen and even mechanical department officers who cling to the idea that the superheater is intended simply as a steam dryer. Instances are not lacking of enginemen carrying the water so high in the boiler that it is continually being carried over into the superheater, which, instead of performing its function of superheating has to abandon part of its heating surface for evaporative purposes. In some cases this practice has even been sanctioned by the minor mechanical officers, and while it is expected, in the case of switch engines, owing to the conditions under which they work causing a tendency to raise the water through the throttle valve, that the superheater will have more or less evaporative work to do, it is difficult to see the necessity for carrying the water so high in the boilers of locomotives in road service.

Aside from any possibility of damage to the superheater, under such conditions it is losing part of its heating surface in order to assist the boiler in evaporating the water, a purpose for which it was not intended, and for which it should not be used. The heating surface of the superheater, when compared with that of the boiler to which it is applied, is so small that

comparatively little water passing over will appropriate so much of the heat that should go to superheat the steam, that the device will be made useless as a superheater. It has been abundantly demonstrated that a high degree of superheat is essential to the efficient working of the superheated steam locomotives, and it will be readily seen that whatever portion of the superheating surface is given to evaporating water will lower the degree of superheat proportionately. No one desires an engineman to take chances of burning a crown sheet by carrying the water too low, but they should be given to understand in the case of superheater locomotives, aside from increasing the work of the fireman and reducing the steam space of the boiler, that by expecting the superheater to evaporate water they are reducing the efficiency of the locomotive. The superheater cannot be expected to give the results desired from it when it has to assist in the work which should be done by another part of the locomotive.

Watering Locomotives in the Engine House

Delays in getting locomotives out of the engine house at the time for which they are ordered occur at times in spite of all efforts made to prevent them. Some parts of the repair work may have taken longer than estimated, or some other unforeseen cause may have contributed to the delay. At such times every minute that can be saved is of the utmost importance, particularly if the locomotive is for passenger service. If water could be taken in the engine house at such times, from 10 to 20 minutes could be saved in the delay, depending on the size of the tank and the amount of water in it at the time. In the Norfolk & Western roundhouse at West Roanoke, Va., a 3 in. water line has been run around the entire building under the roof and so located that it is directly over the tenders. Globe valves with a short hose connection are placed so that one valve will water two locomotives, and when it is thought that a locomotive is likely to be delayed this hose is turned into the manhole of the tender and the latter is filled, so that the locomotive is ready to leave for its train as soon as it passes over the turntable. A water line of this kind costs very little and has great possibilities as a time saver; its application is well worth consideration not only in new engine houses but in those already in use.

Railway Storekeepers' Association

Among the most valuable papers presented at the recent convention of the Railway Storekeepers' Association were those considering the effect of the stores department on the operating costs of a railroad, and the reduction of inactive and obsolete stocks. An excellent example of what a stores department can do to reduce operating expenses is shown by the system in vogue on the Atchison, Topeka & Santa Fe. This road, by judicial and careful planning, so regulates its supplies that a comparatively small percentage of material is held in stock. This is accomplished by a central stores organization, whereby the general storekeeper knows soon after the close of each month just how much stock there is distributed over the whole system. This permits of carrying less stock or, in other words, requires less capital to be tied up in material. This capital may be used for other operating requirements.

The reducing of inactive stock may be accomplished by careful supervision. It is the natural tendency for any department to maintain a rather large amount of surplus or emergency stock to provide for extraordinary demands, but when the general stores department can win the confidence of the other departments and insure the maintenance of a complete, though small, stock, it will be found that less trouble will be experienced with the reduction of this class of material.

G. G. Yeomans stated that the opportunities of the storekeeper were unlimited, and it would seem that this is true, when it is considered that a year's supply of material is held in stock on all the railroads of this country taken as a whole. The reduction in stock means money to a railroad; even the smallest reduction would provide capital that could be spent in other important improvements. When some roads claim that only three months' supply is held in stock it would seem that the storekeepers of other roads are not making the most of their opportunities.

While there were a large number of interesting and instructive papers the scheme of having several members present separate papers on the same subject may be criticized as wasting the time of the association during the convention period. It is practically impossible for five papers to be presented on the same subject without a repetition of many ideas, provided, of course, the authors stick to their subject. A much better way would be to take the main arguments from them all and fuse them into one paper that would represent a thorough and concise presentation of the subject. There is also a tendency for the members to discuss topics while on the floor of the convention that are irrevelant to the subject at hand and sometimes wholly out of the jurisdiction of the stores department. This was especially noticeable in the extended discussion on the status of the engineer of tests and the preparation of specifications. There seems to be a lack of close co-operation that is necessary to make the organization a more effective unit and not infrequently resolutions have been adopted by votes cast in an entirely perfunctory manner which should have been done only after the most careful consideration.

Notes on the Fuel Convention

In most railway fuel contracts, in the bituminous district, there is a maximum and minimum clause which often permits the railway company to demand a daily or weekly amount that varies by as much as 100 per cent. The maximum demand naturally comes at the time of the greatest train movement which is usually the period of the greatest demand for cars, and the greatest difficulty in obtaining cars for coal loading. Furthermore, since this generally occurs in the fall and winter months, it is the time when the demand for commercial coal is largest and the price the highest. Under these conditions, the coal operator is compelled to deliver most of his output to his railroad customers at a price considerably less than he could obtain elsewhere and, in addition, after the railroad demands are supplied, there usually remain comparatively few cars in which he can load commercial coal.

For these reasons, the coal operators are strongly in favor of having the railroads provide storage yards in which they can store coal during the summer months in sufficient quantities to supply their excess demands during the winter. They are sometimes willing to grant some reduction in price if this practice is followed.

Mr. Peabody, president of the Peabody Coal Company, in his address to the association, strongly urged the storage of coal during the summer and suggested the storing of four months' supply. He stated that it would cost but fifteen cents a ton to do this if the proper facilities were provided. Of this amount, ten cents was assumed to cover the cost of depreciation.

Comparatively few railroads make any effort to store bituminous coal in even small amounts except where labor trouble may be pending. One of the principal objections advanced is the reduction in the quality of the fuel due to the extra handling and the weathering. With some coals, this alone may cost thirty-five cents a ton and, unless complete facilities are provided for unloading and reloading, another ten or twelve cents is added to this. Furthermore, the idle investment is a matter to be considered. In but very few cases can a reduction of as much as ten cents a ton be obtained by agreeing to store the excess winter supply, although, in some instances, the coal operator will carry the financial burden. It is thus hard for a railroad company to find that this practice has any advantages,

and but few are planning on extending it, although it is admitted that every practical effort should be made to help the coal mines on its lines.

In one case at least a form of contract is in force which seems to solve the problem in another way. In this the spread, or difference between the maximum and minimum demands permitted, is very small and the contract provides that for all coal demanded by the railroad over its maximum a premium of ten cents a ton will be paid for the first small percentage of the maximum, and twenty cents a ton for the next equal amount, and thirty cents a ton for the next, and so on. Such a contract seems to be thoroughly fair to the coal operator and is not hard on the railroad if the future requirements are estimated as carefully as they should be.

* * * *

That the brown or true lignite can be successfully used on locomotives is proved by the practice of at least two of the railways running through the western coal fields. These are the Chicago & North Western and the Chicago, Burlington & Quincy. The former now has twenty-one locomotives in service which use lignite as fuel exclusively. They were designed especially for this fuel and have a grate area about 50 per cent. larger than would be required for bituminous coal. From the beginning no trouble was found in making steam, but great difficulty appeared in obtaining a front end arrangement that would prevent sparks. The problem was finally solved by the use of an arrangement termed a "gyrus," which was illustrated on page 143 of the March, 1912, issue of this journal. This extinguishes the sparks by using a centrifugal action to throw them against a series of plates. These locomotives are now reported to be successful in every particular.

It is necessary, however, to use lignite very soon after it is mined, as it disintegrates rapidly on exposure to the air. This prevents it from being shipped to even a comparatively short distance and only those locomotives on the divisions where lignite is mined are possible users of it. The most reasonable method of extending its use seems to be by briquetting, and this is now being actively investigated with very encouraging results. It appears that the chief difficulty is to find a suitable binder which will not be so expensive as to make the briquettes cost more than other fuels in the district. It is believed that this will soon be accomplished.

* * * *

A complete manual of firing practice is being prepared by a committee of the Fuel Association, and two full sessions were devoted to the discussion of the preliminary report at this year's convention. This manual will include illustrations and specifications of recommended firing tools, instructions in the best method of manipulating the grates, dampers, blower, etc., under different conditions of operation and quality of fuel, recommended practice in all the details of hand firing and in handling a mechanical stoker, best methods for educating firemen and obtaining their co-operation, how best to interest operating officials in fuel economy, and a list of the ways in which firemen unnecessarily waste coal. This is not, in any way, to be an instruction book for the firemen themselves, but for those whose duty it is to train them and be responsible for the quality of their work. Judged on the basis of the possibilities for large savings, this is probably the most important work that is now being undertaken by any of the railway mechanical associations.

* * * *

"I will guarantee to save 10 per cent. of the locomotive coal if I am given an accurate individual fuel record of the engineers and firemen," was the statement of one of the members discussing the report on coaling stations. This statement was explained to be based on experience with the ordinary coaling station, where the amount is estimated by the engineer or coal chute attendant and with coaling by buckets handled by an air hoist where the amount supplied is accurately known. The same sentiment was echoed by a number of others. The value of the accurate individual performance record—it must be accurate to be of any value whatever—lies not only in the appeal to the pride of the enginemen, but also in the opportunity offered to discover the need of changes or adjustments in the locomotive itself and in any variation in the quality or condition of the fuel.

Some means of accurately weighing the amount of coal put on the tender every time coal is taken, is one of the essentials of such a system. A more or less elaborate system of reports and records is also needed for the best results. So far as appeared, there is but one railway that has such a system in practice on a large scale. On the Atchison, Topeka & Santa Fe the coaling stations have weighing hoppers, and the reports are most complete and comprehensive* in their character. The results have proved to be even better than had been anticipated in the beginning and savings of surprising amounts were claimed and demonstrated. The sentiment of the meeting was strongly in favor of weighing hoppers or some other means of obtaining the exact amount of coal put on a tender.

In connection with the same report, the depreciation of the fuel caused by its passage through a mechanical coaling station was strikingly demonstrated by a series of photographs. These showed the coal on the car; as it appeared in the storage bin of the coaling station, and as it appeared on the locomotive tender.

* * * * *

The associations which are of the most value to their members and the railways are those that select appropriate subjects and give them full discussion, arriving at a definite conclusion or a future line of action. To do this with any subject that is worthy to be brought before these conventions, takes considerable time. In this respect the International Railway Fuel Association stands among the best of the mechanical associations. Seven subjects were selected for four days' work. This gave but two subjects to be considered for each day except the last. It was thus possible to devote a whole day of eight hours to two subjects if necessary. This, coupled with a presiding officer who compelled the speakers to confine their remarks strictly to the subject under discussion, made the convention unusually satisfactory in every particular. Other associations would do well to follow the same practice.

The subjects proposed for consideration at the next convention include a number of special importance, and indicate that the interests of the membership are broader than might be supposed from the name of the association. They include some dealing with features of locomotive designs that have an effect on fuel economy, *viz.*, front end arrangement and design of grates and ash pans. Locomotive stokers are also proposed as a subject for report and discussion. Other subjects are, sizing of coal, weighing coal, motor car fuel, in addition to the reports of the standing committees on firing practice and coaling stations. It is not expected that all of these will be brought up next year, but from this list five or six subjects will be selected.

NEW BOOKS

Safety Valve Rating. By Alfred G. Carhart, C.E. Illustrated. Bound in paper. 6 in. x 9 in. 105 pages. Published by the author at 10 Roland street, Charlestown, Mass. Copies free.

This book is probably the most complete technical discussion of the factors that enter the formulation of rules for safety valves that has ever been published. All the features of design of the valves and their relation to the boilers to which they are applied are thoroughly considered, and three new rules differing from anything heretofore suggested are proposed. The calculations leading to these rules are given in detail and each step is made clear to any reader at all familiar with the subject.

*See *American Engineer and Railroad Journal*, May, 1910, page 161.

AIR BRAKE ASSOCIATION CONVENTION

Several Important Reports Were Presented at the Annual Meeting, Which Was Well Attended.

The twentieth annual convention of the Air Brake Association was held at the Planters Hotel, St. Louis, May 6 to 9, President W. J. Hatch, general air brake inspector of the Canadian Pacific, presiding. The president, in his address, called attention to the importance of the proper maintenance of the air brake equipment, not only from an economical standpoint but also for the safety of the general public; he emphasized the fact that that the members were in a position to produce by efficient work a decrease in the maintenance costs, especially of freight equipment. He strongly recommended the terminal testing plants by which the air brake equipment of trains may be immediately tested on their arrival at the terminals, pointing out that by this method defective equipment may be located and thoroughly repaired before the cars are required to go out on the road again. He spoke of the air hose failures as being one of the most troublesome features in air brake maintenance, especially in northern climates where the extreme cold freezes the hose so that it is practically impossible to keep the hose connected while on the road. In this respect he advocated the use of hose that would resist this freezing action, and as a general proposition raised the question as to whether or not it would be practical for the M. C. B. Association to adopt a time limit for the hose to be held in service, in this way anticipating a large percentage of the hose failures and greatly decreasing the damage done to equipment from these causes.

The secretary's report showed a total of 788 active members and a cash balance of $2,619 in the treasury. About 275 members registered at the convention, and the meetings throughout were well attended.

Four of the papers which were read are so intimately concerned with the work of the car department that they are included in the Car Department section of this issue as individual articles. They are "Undesired Quick Action, Its Prevention and Remedy," by C. N. Remfry; "Will the Triple Valve Operate as Intended," by S. W. Dudley; "Air Hose Failures," by T. W. Dow, and "Location of Steam Heat Traps," by C. W. Martin.

OPERATING LONG FREIGHT TRAINS.

F. B. Farmer, of the Westinghouse Air Brake Company, read a paper on this subject, an abstract of which follows:

Next to safety comes the less spectacular, but very potent argument of needed economy in cost of transportation. An editorial in the *Railway Age Gazette* of February 7, 1913, says: "From 65 to 80 per cent. of the damage to freight cars is caused by defective draft gears," basing this on a statement by a master car builder of a large road. Part of this damage is caused in train handling, and while inherently weak draft gear and gear allowed to leave terminals in a defective condition contribute to break-in-twos, yet, as good handling will, even under such adverse conditions, avoid many failures that occur, the opportunities for improvement are obvious. Our efforts should be toward keeping trains moving toward destinations without damage. That this may be done, and safely, requires, of course, some standing time for testing and repairs, but this merely emphasizes the need of avoiding unnecessary damage and delay.

Air Brake Instruction.—The instruction facilities of an air brake instruction car, including the instructor, are of value in so far as they contribute to safer, more expeditious and more economical train movement and no farther. Too often the air brake man, outside of, as well as in the car, allows his interest in some details to obscure the main object, and thereby accomplishes less of the desired results than he could. Enginemen should, of course, be given a working knowledge of the construction and operation of the engine and car brake apparatus so they may operate and test it intelligently and make needed reports of defects. But too often the construction, operation and defects are dwelt on to an extent that excludes adequate consideration of the main theme, manipulation or train handling. In fact, with the fundamentals of construction and operation explained, any elaboration should accompany and develop from instructions on manipulation, and will thereby be less dry, better appreciated and more valuable.

The instructor, to succeed, must realize, and ever keep in mind, that the air brake is a means and not an end; that it is to promote train movement as far as is compatible with safety and economy; that this is obtained largely in train handling (starting, running and stopping), and that all instructions on train handling should be based on the fundamental and all-important fact that with draft rigging in fair to good condition no damage in train handling (not including switching) will follow if the slack is not allowed to run in or out harshly. The facts that the head brakes commence to apply and to release earlier than the rear ones; that with the same application brakes hold better as speeds are lower; that brakes retard empties better than they do loads, etc., are of lessened value to all engineers and of no value to some unless directly associated with their effect on slack action. All instruction on train handling must be based on and tied to train slack control, must teach engineers the various causes for slack running in and out, and how to use the brakes, the steam and the sand to prevent harsh slack action.

The instruction car work is merely the beginning, and if it is not followed up by individual instructions and observations on the road the results will be disappointing and out of proportion to the time expended. If either must be slighted it should be the car instructions. Especially on large systems that do not have district air brake men, and even where the latter are had, all of the regular, individual instructions in service must be given by the traveling engineer. Therefore, the main duty of the air brake man should be to thoroughly post the traveling engineer, both in the car and by riding trains with him and demonstrating, mainly for his benefit, by personal directions to engineers and by handling trains.

Break-in-Two Records and Investigations.—Without reasonably accurate and complete records of every break-in-two officials are working largely in the dark, and accurate and complete reports are impossible without suitable forms. The conductor and the engineer must be shown by such forms just what information is wanted, and the writing to give it must be reduced to a minimum. The first report of each should indicate on its face whether anything farther than a record is necessary. If so it should ordinarily require little investigation preliminary to a decision.

The importance of investigations and the necessity for suitable report forms are indicated in the following extract from a committee report made at a meeting of operating officials of the Illinois Central, by J. L. East, agent of the loss and damage bureau:

> The matter of rough handling of trains can be readily corrected if those connected with the transportation department holding supervisory positions will follow up closely with their superior officers any rough handling of trains coming under their observation in a sufficiently perceptive manner, to enable proper investigation of each specific case. It should be possible to surround this whole question of rough handling of trains on road, as well as in terminal yards, with such close and constant supervision through the co-operation of the entire division staff, as to make possible a thorough investigation of at least the majority of cases of rough handling occurring on any division. This is a matter of the most importance, and there is no question but that a great improvement in the way of reducing claims can be made.

Train Handling.—Draft rigging in fair to good condition is not pulled out. It is either driven in or jerked out, both implying a severe blow. The severity cannot be judged by any shock felt by those riding trains, particularly the engineer of a heavy locomotive. For a shock to be felt the speed must change suddenly and considerably. The amount of the instant reduction in speed of a modern freight locomotive necessary to cause a break-in-two, is too little to be felt. Engineers who do not understand this are prone to attribute resulting failures to the condition of the draft rigging instead of to their handling. Another overworked explanation for draft gear failures is "old defect."

Records show, regarding break-in-twos with ordinary freight trains of from 1,700 to 2,400 tons, that 20 per cent. to 25 per cent. occur within five cars from the engine; about 40 per cent. between the engine and tenth car, and 60 per cent. to 65 per cent. between the engine and twentieth car, conclusive proof that it

Duluth, Missabe & Northern Railway Co.

ENGINEER'S BREAK-IN-TWO REPORT

*Train*____ *Direction*____ *Date*____ *Eng. No.*____ *Condt*____

*Total Cars Coupled Loads*____ *Empties*____ *Number Empties behind Loads*____

*Time*____ *Delay Hrs.*____ *Min.*____ *Nearest mile post or station (Give branch letter)*____

*Was train Starting*____ *Stopping*____ *Running*____ *Backing*____ *Switching*____

*If starting was slack taken?*____ *How?*____

*Was steam being used?*____ *Light*____ *Heavy*____ *Speed at break-in-two*____

*Were brakes being released?*____ *If so, at what speed?*____

*Were engine or train brakes being used?*____ *Speed when shutting off?*____

*How long before brakes applied*____ *Am't first red'n*____ *Speed then*____

*Am't. final reduction*____ *How far from stop*____ *Total reduced just before final reduction.*____ *(Note: Where engine brakes, independent or straight-air used, give brake cylinder pressure where reduction asked for.)*

*Any previous severe shocks?*____ *Where?*____ *Cause?*____

*No. of cars from engine where break occurred?*____

*State fully your reason for break-in-two*____

*Engineer*____

Make reports in duplicate and mail original to Traveling Engineer and duplicate to Train Master.

Engineer's Break-in-Two Report.

is the harsh running out or pulling out of slack at the head end that does most of the damage in train handling.

As it is a false pride that prevents some engineers from encouraging the conductor to advise of any severe shocks to the rear of the train, the wise man will pocket his pride and get this information, appreciating that in no other way can he judge how to handle trains without damage toward the rear. This simple and commonplace suggestion is very important in good handling.

Starting a freight train properly requires fundamentally that the engine be kept at a slow and uniform speed until the rear car is moving. The distance to accomplish this will vary. Stopping properly will usually bunch the slack sufficiently for starting, but if slack has to be taken it should be either a foot or two or that of the entire train. Stalling in starting, taking the slack on part of the train and then trying to start is very bad practice. Almost unconsciously the engine is allowed to gain such headway as to generally do damage when the stretched portion of the train is reached.

G. B. Pierce has had considerable experience running a Mallet pusher. Stalled one night with over-tonnage he arranged with the others of the crew to try a new plan of starting. The head man was to do all he could and then keep his throttle open moderately, but prepared to ease off as much as necessary when he was started so as to avoid a lurch. Mr. Pierce took as much slack as deemed necessary, then started carefully, simply. The results proved so satisfactory that the method was repeated where necessary with other trains and is now the standard on that road. Its logic is apparent, as the helper cannot drive the slack into the head end and the two engineers are more certain to work together. Also, draft rigging will stand more thrust than pull.

Running, including slowing but not stopping, demands first that the engineer know how the curvature and change of grade will affect the train slack and that he make such use of steam, sand and the air brakes, including the independent engine brake, as to prevent any severe shocks. Instances are known where changes of grade caused the slack to run in harshly from the rear and in spite of steam being used heavily to prevent. The remedy is to bunch the slack carefully with the independent brake just before reaching the point where it would otherwise run in heavily. It is always undesirable to shut off suddenly where steam is being used heavily, but particularly so at a point where the track conditions alone would cause the slack to run in.

Stopping, like starting, is where much of the damage is done. Stopping long freight trains with the engine brakes only should generally be discouraged. Granted that it can be done with many advantages where conditions favor, as they frequently do, yet the fact is too often attested by trainmen, particularly those in the caboose, that it is abused. Some engineers either apply it too heavily or, if light enough, do not wait long enough to get the slack in to the rear before applying harder. Again, this part may be done well, but the brake be held applied to the stop Its power should always be reduced nearing the stop and completely released if on even a gently ascending grade. Otherwise, the compressed coupler springs will run the slack back fast enough to do damage. The only safe general recommendation is to use the train brakes when stopping with more than a few cars.

Mr. Farmer closed his paper with detailed instructions in train handling for freight engineers.

Discussion.—This paper was enthusiastically received. While many of those present stated that their instructions to enginemen were very similar to those Mr. Farmer presented, several questions were raised which were of a more special nature than could be covered in the paper.

W. W. Schriver (B. & O.) mentioned the operating of 160 car trains which he had found impossible because of the difference in train line pressure between the head end and rear end of the train. The question of the permissible difference in head end and rear end brake pipe pressure was raised, many members stating that on long trains it seems unnecessarily large. This was due perhaps to excessive train pipe leakage or the incorrect reading of the gages, as there should not be a difference much greater than 5 or 6 lbs. Mr. Wood, of the Santa Fe, explained that his road would not allow a train pipe leakage of more than 5 lbs. per minute.

Experiences were narrated where trains would break-in-two without the engineer knowing it, but it was clearly shown that if the train pipe had been charged to its full pressure this could not happen. There are cases of trains standing with the engine disconnected, while taking water and coal or to do switching, where the air will leak out of the train pipe, allowing the brakes to release. If, after the engine is coupled to the train again, it starts before recharging the train pipe it is possible for a break-in-two to be experienced without the engineer realizing it. The train pipe would then have an open end and the

compressor would not be able to build up a train pipe pressure large enough to operate the brakes under this excessive leakage. It was, therefore recommended that sufficient time be given for the compressor on the engine to fully charge the train pipe and that the brakes be tested before leaving.

OTHER BUSINESS.

Among the other speakers at the convention were E. F. Kearney, vice-president of the Missouri Pacific; J. F. Enright, superintendent of motive power and equipment of the Denver & Rio Grande, and Walter V. Turner, chief engineer of the Westinghouse Air Brake Company. Mr. Kearney stated that now, as never before, was the loyalty of railway employees necessary to keep the equipment in the best possible condition, for the railways, being handicapped by government rulings, must exercise the utmost care in keeping down the cost of operation.

Mr. Enright stated that he realized the great importance the air brake men play in train operation, since the Denver & Rio Grande is located in a very mountainous district, where it is necessary that the air brakes be maintained in a very efficient condition. His greatest difficulty is in not receiving cars on his lines in sufficiently good order to get them over the road. This is probably due to the fact that the delivering roads, which were, as he termed them, valley roads, did not find it necessary to have the brakes at their highest possible efficiency. In accepting trains it has often been found that 50 per cent. of the cars were not in suitable condition to be carried over mountainous lines.

Walter V. Turner gave an informal talk to the members of the association in the afternoon of the second day of the convention.

The executive committee voted as the sense of the association against the formation of a supplymen's association to work in conjunction with the Air Brake Association, desiring to furnish their own entertainment at the conventions.

The following officers were elected for the ensuing year: W. J. Hatch, Canadian Pacific, president; L. H. Albers, New York Central Lines, first vice-president; J. T. Slattery, Denver & Rio Grande, second vice-president; T. W. Dow, Erie, third vice-president; F. M. Nellis, Westinghouse Air Brake Company, secretary, and Otto Best, Nathan Manufacturing Company, treasurer.

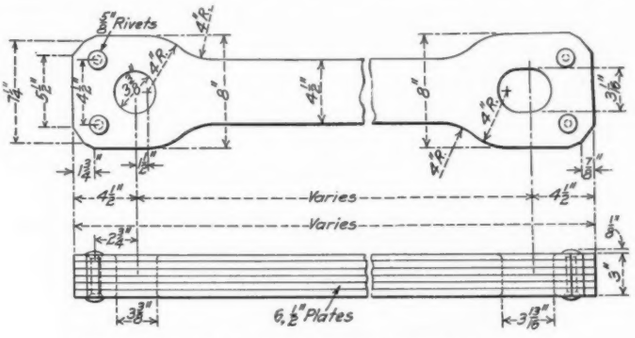
LAMINATED LOCOMOTIVE DRAWBAR

Several railways are now using drawbars between the locomotive and tender which are composed of several layers of steel plate, secured together at the ends, instead of a solid wrought iron bar as has been customary. The wrought iron drawbar may contain interior defects which do not show until after failure, and this new steel plate bar has been developed largely for the purpose of obtaining a design which would give a preliminary warning of any weakness. Experience has shown that it is very successful in this particular and, although it costs from 15 to 20 per cent. more than a forged bar, it is easy to repair, as in case of failure, one plate only will break and this can be removed and replaced by a new one at a slight expense and the bar may be promptly returned to service. Drawbars of this type cannot be used where it is necessary to offset for a difference in the height of the engine and tender.

Steel Plate After Having the Ends Shaped and the Rivet Holes Punched.

A drawbar of this kind in use on the Canadian Pacific is shown in the illustration. It has six ½ in. mild steel plates, held together by two rivets at either end. The section at the center is 4½ in. wide; it is 8 in. wide at the ends. When these bars were first designed, spring steel was used, but it has been found that mild steel is much more satisfactory. In the early design also three rivets were applied at either end, the third one being inside of the drawbar pin hole and on the center line. It was soon found, however, that the bars would fail by cracking from this hole diagonally outward to one side and therefore this third rivet has been eliminated and no further failures have developed at this point.

In manufacturing the bars, the ½ in. plates are cut to a width of 8 in. and a length to suit the class of locomotive for which they are intended. The ends are then heated and cut to shape in a hydraulic flanging press to which special dies and cutters are applied. The appearance of the plate after this operation is shown in the photograph. After both ends are stamped out, the rivet holes are marked and are then punched 1/16 in. smaller than the finished diameter. The next operation is to shear off the superfluous metal between the heads in the shank of the plate. This is done without heating. The plates are then put together, the rivet holes are reamed to the proper size and the rivets are driven. The bar is marked off for the drawbar pin holes, which are drilled to size, and the oblong hole in the one end is milled to the proper shape.



Drawbar Made of Steel Plates; Canadian Pacific.

On this road the use of the laminated drawbar is not confined to any one class of locomotive nor to locomotives equipped with any special device, such as a radial buffer device between the engine and tender, but is used wherever the solid drawbar has been employed except in the case of an offset bar.

STEAM CAR FOR NAVIGATION.—Mr. Benjamin Phillips, architect, of Philadelphia proposes to construct a steam car to travel on rivers at a speed of 20 to 25 miles per hour to carry one hundred passengers, to draw 15 inches of water, to be only one-third the weight of any other ordinary steamboat of the same dimensions now afloat; of far superior strength and safety, constructed on entirely new principles; the whole material except the engine and boiler to cost about $1,600 completely furnished and ready for operation by the first day of May next.—*From the American Railroad Journal for January*, 1833.

EARLY RAILROAD TRAVEL.—We are requested to state that there has not been a day since the opening of the Camden & Amboy Railroad that the Philadelphia and New York passengers have not been taken over the road each way with the exception of Saturday and Monday last, notwithstanding the recent heavy falls of snow. On those days there were no passengers from Philadelphia owing to the company's not being able to procure coaches to convey passengers from Philadelphia to the railroad. The passengers that left New York on the above-mentioned days were taken over the railroad in cars and forwarded to Philadelphia the same evening in sleighs. The stage arrangements being now completed, passengers will be conveyed from the railroad to Philadelphia in coaches until the river Delaware opens.—*From the American Railroad Journal, March 9, 1833.*

RAILWAY FUEL ASSOCIATION CONVENTION

Recommended Firing Practice Among the Subjects Discussed at the Fifth Annual Meeting.

The fifth annual convention of the International Railway Fuel Association was opened at the Hotel Sherman, Chicago, on May 21 by the president, H. T. Bentley, assistant superintendent motive power and machinery, Chicago & North Western. After prayer by Rev. William C. Shaw, Mr. Bentley, in addressing the meeting, drew attention to the growth of the association from 35 to over 500 members in the five years of its existence. He suggested that a paper be prepared by a committee of coal operators outlining what is being done to increase the percentage of coal removed from the mines to the total amount in place. Some of the more important suggestions in this address are given below.

PRESIDENT BENTLEY'S ADDRESS.

Several of the larger roads have found it profitable to organize a regular fuel department for the purpose of checking waste, instructing enginemen, etc., and with a very limited organization it has proved a good investment. It is, however, possible to get better results on nearly all roads with practically no additional expense, if everybody will co-operate. We should first see what can be done under conditions as they exist, and later, when we are sure of our ground, make such recommendations that we can back up with figures, to show that we are justified in asking for improvements.

On account of the constantly increasing cost of fuel, a special effort must be made to use the lower grades of coal, and also the true lignite, which can be burned successfully with a properly designed firebox, boiler and front end arrangement. In certain localities there is a demand for lignite coal for commercial use during the winter months only and, as a result, it hardly pays to operate the mines six months of the year; but, if it was used on locomotives, it could be mined all the year and thus result in building up the industry for the benefit of both the coal and railroad companies.

Bulletin 14, issued by the Bureau of Mines, states that there are about 150,000 square miles of workable lignite beds in this country, It is estimated that there are 104,544,000,000 tons of this fuel available. If briquetted, its heating value is increased nearly 50 per cent., and as certain samples submitted from North Dakota for test were made into briquets without the addition of an artificial binder, it would appear as if this subject should receive more attention than it has in the past. Only 8,451,365 tons were mined during 1911.

Efforts have been made at different times and by different railroads to burn pulverized coal, but, from the fact that nothing has been done for the past few years, it is evident that very serious difficulties were encountered and it is, therefore, of interest to learn that the subject is again being taken up in a very thorough manner by one of the railroads. We may hope to hear something about it before long. The obstacles heretofore appear to have been in the inability of the fire-brick to withstand the intense heat generated, and to properly pulverize and store the coal in a locomotive tender. If we could utilize pulverized coal in a locomotive firebox satisfactorily, it would definitely solve the problem of the large engine and the capacity of a fireman.

During the winter months, in the northern states, there is difficulty in moving cars and a greater demand for them than in the summer. The coal operators and railroads are harassed to give more prompt service and under greater difficulties than in the warm weather, so that if railroad and commercial coal could be stored in central locations during the summer months near where it is to be used, and distributed from there late in the season, it would often save the long haul under adverse weather conditions. While there is some loss on account of slacking, unloading and picking up, etc., I believe the cost could be reduced by the mine operators for coal furnished when the commercial demand is less and the handling of empty cars to the mines could be considerably reduced during the cold weather.

The use of larger passenger and freight locomotives has in a number of cases decreased rather than increased the amount of coal consumed in doing a given amount of work; this being more noticeable when the engine in the first place was worked up to its capacity to handle a heavier train than it was designed for and a larger engine put on that could haul the loads easily, the saving effected in some cases being as high as 15 per cent.

MR. QUAYLE'S ADDRESS.

Robert Quayle, superintendent of motive power, Chicago & North Western, strongly urged the adoption of every practical means for increasing the efficiency in the use of fuel. He believed that larger grate areas on locomotives were advisable and laid special stress on the value of better prepared coal for locomotives. Coal pushers and other devices to aid the fireman should be applied. Brick arches are of great value and all types of locomotives, even switchers, should be fitted with superheaters. Team work between the engineman and fireman should be fostered in all cases.

MR. PEABODY'S ADDRESS.

Francis S. Peabody, president of the Peabody Coal Company, outlined some of the problems of a coal operator in an impressive manner. The amount of coal now left in place in the mines after operations are finished is about 40 per cent. It is easily possible to remove all the coal, but, in doing it, the cost is considerably increased on all the coal taken out. The present methods are those which give the cheapest product. He referred to the hardship on the coal operator by the enforcement of the maximum and minimum clause in the contracts. The maximum tonnage is always demanded by the railroad when the price is the highest and cars fewest. Also just before a strike. In this connection Mr. Peabody stated that the railroads were often directly responsible for the success of miners' strikes because of their action in offering a high premium for coal and causing some operators to break their agreement with the others. The strike of 1912 was mentioned as an illustration. This strike resulted in an increase of six cents a ton in the cost of coal.

He strongly favored the storage of coal by railroads and believed that four months' supply, at least, should be stored during the summer months. The building of trestles for unloading coal to be stored and steam shovels for again loading, was recommended. He stated that the cost would not exceed 15 cents a ton, of which 10 cents would be the loss due to depreciation and 2 cents for unloading. This apparently applied to a particular grade of fuel.

Mr. Peabody gave the increase in the cost of coal during the past 15 years for his company. In 1897 the cost was 25 cents a ton at the mine. At present it is 90 cents. Sixty per cent. of this increase is due to increased cost of labor. Of the present cost of 90 cents a ton, less than 3 cents is for the coal itself.

Secretary's Report.—The secretary's report showed a membership at the opening of the convention of 523. At the close of the meeting it was announced that the membership was 590.

STANDARD FORM OF CONTRACT

The committee on this subject submitted a proposed standard form of contract which included specifications as to the mines from which the coal was to come; a provision of maximum and minimum daily and weekly tonnage; an understanding to determine the proper percentage of the order which must be fur-

nished in times of car shortage; a provision that coal loaded longer than ten days would not be acceptable; agreement as to methods for weighing under different conditions; a preference clause giving the railroad the first call on the mine's output; inspection agreement; prices and an understanding in the event of strikes. The committee consisted of J. G. Crawford, chairman, H. L. Badham, E. A. Foos, I. C. Hatch and B. T. Jellison.

DISCUSSION.

Objection was raised to a feature of the proposed contract which specified the way in which coal could be delivered in case of a car shortage. It was urged that the matter of supplying cars and the purchase of coal should be kept separate. It was also suggested that the invoices should carry the serial way-bill numbers. The question of including some specification as to the quality of the coal in the contract was advocated by some members. One wished it to include the heat value and the percentage of ash, and another speaker proposed a specification as to the minimum temperature at which the ash would fuse. It seemed that none of these suggestions were practical in a railroad contract as they would have to take the coal the mines on their lines could produce. So far as appeared no railroad is purchasing on a sliding scale of price varying with the heating value.

SUB-BITUMINOUS AND LIGNITIC COAL.

Samuel B. Flagg, engineer, Department of the Interior, Bureau of Mines, read a paper on this subject, an abstract of which follows:

Availability is one of the principal factors governing the cost of fuel for any road, and for this reason, largely, some roads or divisions are using wood, others are using oil, and still others anthracite, bituminous, sub-bituminous, or lignitic coals or coke. In some foreign countries peat has also been tried, but, so far as the author knows, without great success.

Unfortunately the dividing line between lignitic and sub-bituminous coals and also between sub-bituminous and bituminous coals cannot be sharply drawn. In general, however, lignitic coals are characterized by a high moisture and high volatile matter content, by a fairly low percentage of ash, and by a low heat value. They are of a brownish color, have a woody appearance as regards their structure, and give up their moisture and disintegrate rapidly upon exposure to the atmosphere.

The lower grades of sub-bituminous coal differ from the lignites mainly in their appearance, as is indicated by the designation, "black lignites" that is frequently given them. These lower grades of sub-bituminous coal, like the lignitic coals, are high in their moisture and volatile matter contents and low in heating value. Their behavior on exposure to the air is also similar to that of the brown lignites, but the structural resemblance to wood is much less marked and, in many cases, is absent. The better grades of these sub-bituminous coals, on the other hand, have a much lower moisture content and a higher heat value; in fact, the heat values of some of them are considerably higher than those of many of the bituminous coals. Even these high grade sub-bituminous fuels, however, have the same tendency to disintegrate on exposure to the air, and the same is true upon exposure to heat in a furnace. Another characteristic feature of both the lignitic and sub-bituminous coals is their liability to heat in the pile or bunker and to take fire spontaneously. This difficulty is experienced with many of the bituminous coals as well, but is not so uniformly encountered with such coals as with the lower grade fuels.

A few typical analyses of fuels from some of the different fields are given in the table below, the last two being classed by the United States Geological Survey as medium grade bituminous coals, although they are frequently designated as sub-bituminous or lignitic coals.

It has been estimated that of the coal easily accessible and still remaining in the coal fields of the United States one-third is represented by the lignitic and the sub-bituminous deposits.

Mining costs in the different fields producing sub-bituminous coals vary considerably, probably ranging between $0.80 and $1.70 a short ton as extreme values. These costs, of course, are proportionately higher where the output is small than where the development has been more extensive. They are also affected by

Proximate Analysis.	Gebo, Bighorn Co., Wyo. Slack Coal. (Sub-Bit.)	Hannah, Carbon Co., Wyo. (Sub-Bit.) U. P. R. R.	Hudson, Fremont Co., Wyo. (Sub Bit.) C. & N. W. Ry.	Roundup, Musselshell Co., Mont. (Sub-Bit.) C. M. & St. P. Ry.	Erie, Weld Co., Colo. (Sub-Bit.) U. P. R. R.	Gallup, McKinley Co., N. Mex. (Sub-Bit.) Lump, Nut and Slack.	Williston, Williams Co., N. Dak. (Lignite).	Rock Springs, Sweetwater Co., Wyo. (Bit.) U. P. R. R.	Superior, Sweetwater Co., Wyo. (Bit.) U. P. R. R.
Moisture	16.58	6.72	8.37	7.83	15.84	11.90	42.88	7.32	7.40
Vol. Mat	31 97	45.06	41.10	32.66	34.55	37.85	24.22	39.83	40.17
Fix. Car	46.05	39.51	48.02	53.63	43.95	41.57	24.96	45.37	46.95
Ash	5.40	8.05	3.51	5 88	5.34	8.68	7.94	6.42	4.57
Sulphur	.64	66	.38	.22	.32	.56	1.53	1.06	.91
B. T. U.	10609	11462	.....	12771	10215	11077	5683	12017	12283

the character of roof and other physical mining conditions, by the cost of timber for props, and by the prevailing scale of wages. Some idea as to the costs of production in some of the sub-bituminous and some of the bituminous fields can be gained from the following figures:

Location of deposits.	Production cost per ton.
Carbon County, Mont. (Sub-bituminous)	$1.40 to $1.60
Bighorn County, Wyo. (Sub-bituminous)	1.10 to 1.40
Sheridan County, Wyo. (Sub-bituminous)	.70 to 1.38
Boulder District, Colo. (Sub-bituminous)	1.05 to 1.10
Gallup District, N. Mex. (Sub-bituminous)	1.25
Illinois Field (Bituminous)	.85 to 1.40
Pennsylvania Field (Bituminous)	.85 to 1.25
West Virginia Field (Bituminous)	.87 to .90

The substitution of these low grade coals for bituminous fuel introduces, in addition to other difficulties, a number of problems of operation. Because of the generally lower heat value and the difficulty of realizing this value in the firebox it is obvious that a much larger quantity of coal must be burned in a given time in order to develop the required horsepower. For this reason the grate area must be greater—one authority says 50 per cent. greater—than would be required for good bituminous coal.

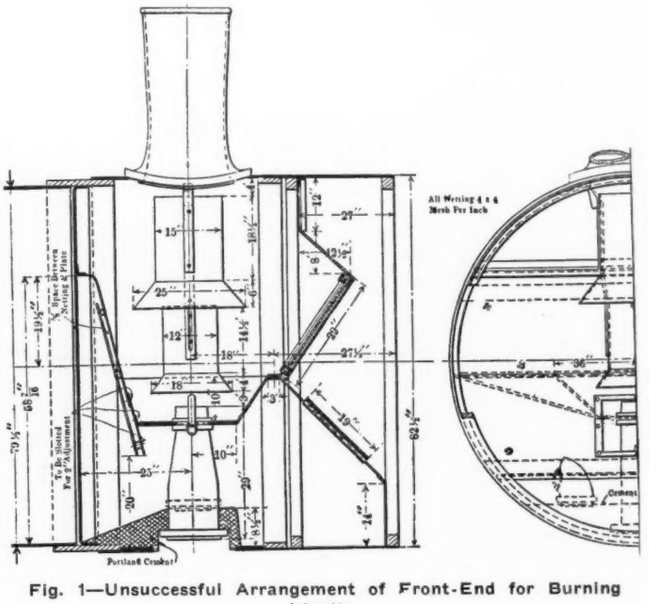


Fig. 1—Unsuccessful Arrangement of Front-End for Burning Lignite.

The disintegrating action of the heat further complicates matters by increasing the resistance of the fuel bed to the flow of air through it. High drafts are necessary to overcome this resistance and maintain the required rates of combustion, and to get them, the exhaust pressures must be increased to such an extent that the efficiency of the locomotive is reduced 5 to 10 per cent. thereby.

One point in favor of these sub-bituminous coals that should not be overlooked is the freedom from clinker troubles. The percentage of earthy matter in them is usually low—in many instances under 5 per cent.—and the sulphur content is also low. If the refuse has any clinkering tendency at all, the clinker is of such a nature that it is easily broken up and therefore introduces no serious operating difficulties.

In some sections the greatest problem connected with the use of sub-bituminous fuels has been the one of preventing spark troubles. Because of the high drafts necessary for burning these coals and on account of the absence of any coking properties

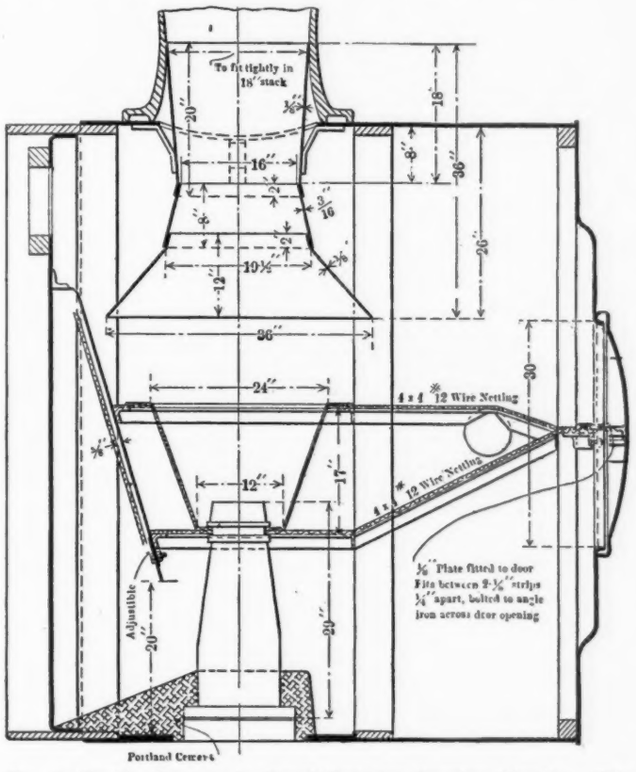


Fig. 2—Double Screens in Front-End for Burning Lignite. This Arrangement Has Been Discarded.

of the fuels, large quantities of sparks are carried out of the firebox. These sparks must either be caught by some arrangement of screens, or so delayed in passing out that they are cooled down to a temperature at which they will do no harm, or they must be broken up into particles of such small size that they will be dead before reaching the ground. The first attempts to solve this problem were made with different sizes and arrangements of screens and usually included two screens for the gases to pass through. Examples of such front-end arrangements are shown in Figs. 1 and 2. It was usually found, however, that one of the screens clogged and prevented the free steaming of the engine. By using a single screen, properly set, most of the clogging trouble can be done away with, unless there is a steam leak in the smoke-box or wet slack coal is being used, and some roads claim to have found the screen as satisfactory and effective as any means for eliminating spark troubles. Screens set horizontally will, with some forms of stacks, remain clear longer and give less trouble than if set on an incline, and likewise small mesh netting of small wire is more satisfactory than small mesh netting made of large wire.

In using these small mesh screens in locomotives burning sub-bituminous coals it is very important that no holes be left around the edges of the screen or where it comes in contact with steam pipes, as any holes of this sort will give serious trouble. The front ends should be so arranged that they may be readily inspected and cleaned, and it is of the greatest importance that inspections be frequently and thoroughly made. Fig. 3 shows single-screen arrangements that have given good results.

A front-end arrangement designed to reduce in size the sparks or cinders, and also delay their delivery from the stack, is shown in Fig. 4, patents on which are held by the American Locomotive Company. On the western lines of one road a number of locomotives have been equipped with this device and it is stated that the sparks are reduced to such small size that they give no trouble. Some of the engines so equipped have been in service as long as four years and others for over two years, and during this time no fires have been set by sparks from them, although they are operated on the most dangerous divisions of the line.

Another front-end arrangement for sub-bituminous coal burners is shown in Fig. 5. This device was designed by one of the road engineers of a western road and has been used principally in locomotives burning coal from the Roundup, Mont., district. With this arrangement the sparks do not pass through any screens or netting, the success of the device depending rather upon the delayed delivery of the solid particles, thus allowing them time to cool down. A roughened plate of ¼ in. steel is attached to the regular baffle plate at the front flue sheet and this, together with the table plate, fastened to a flange on the upper end of the exhaust pipe, deflects the sparks and gases,

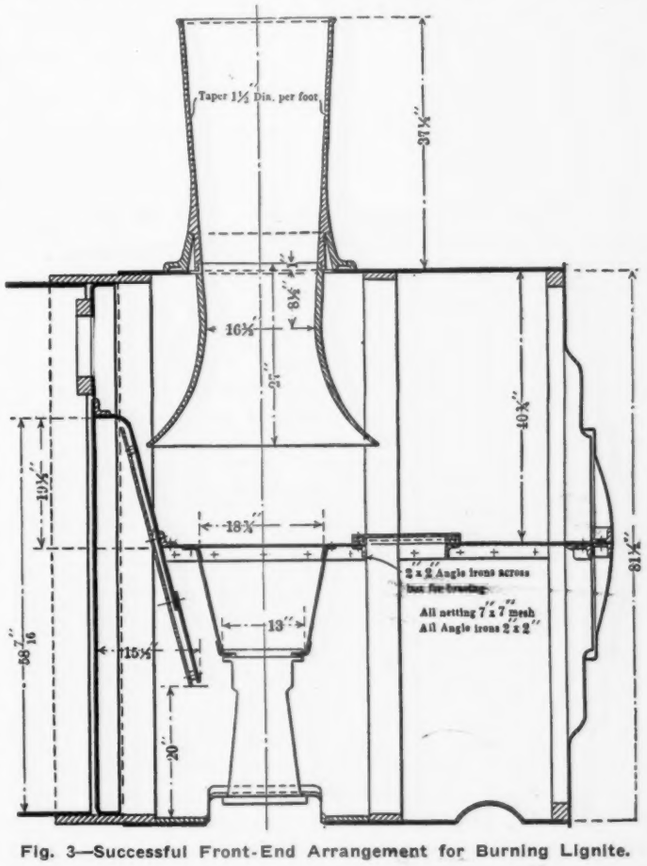


Fig. 3—Successful Front-End Arrangement for Burning Lignite.

causing them to pass to the front of the smokebox. A liner plate attached to the front-end door serves as another deflecting plate. From this point the paths of the sparks and gases are indicated by the direction lines and arrows. The top and bottom sides of the plate midway between the two petticoat pipes are faced with 4 x 4 mesh No. 8 netting, shaped as shown in the drawing. Sparks in passing between the housing surrounding the petticoat pipes and entering the latter strike these screens and are broken up into smaller particles before being discharged out of the stack. It is stated that this device will absolutely control the giving off of sparks, floaters or fires of any description.

In the following table are given some of the principal data and

results of road tests made by different railroads to determine the value of the lower grade fuels. The coals from Las Animas, Colorado, and from Buxton, Iowa, are bituminous coals; the others are classed as sub-bituminous, although most of them are probably referred to more or less frequently as lignites. So far as the writer knows none of these coals in question have the very high moisture content or the other identifying lignite characteristics such as those of the Williston, N. Dak., fuel, analysis of which is given in the previous table.

Gross Ton-Miles.	Number of Cars in Train.	Train Weight, Tons.	Coal Used, Pounds.	Water Used, Gallons.	Equiv. Evap. f and a 212° F. per Lb. of Coal Fired.	Average Speed-Miles per Hour.	Coal—source and grade.
86,594	11.67	632.0	24,916	14,724	5.95	29.65	Hannah, Wyo., Sub-Bit.
88,291	11.33	633.3	33,120	14,304	4.34	28.30	Erie, Colo., Sub-Bit.
213,149	51.66	1,888.9	42,360	27,255	6.47	17.15	Hannah, Wyo., Sub-Bit.
209,541	55.33	1,853.0	57,311	28,435	4.99	14.30	Erie, Colo., Sub-Bit.
.....	7.2	.....	17,960	10,265	5.86	32.90	LaFayette, Colo., Sub-Bit.
.....	7.5	.....	11,650	10,030	8.76	33.20	Las Animas, Colo., Bit.
161,117	34.0	1,445.0	17,749	11,900	6.83	.....	Roundup, Mont., Sub-Bit.
145,011	.....	.....	34,034	19,575	....	23.1	Hudson, Wyo., Sub-Bit.
113,387	21.5	588.9	38,726	21,841	....	21.9	Hudson, Wyo., Sub-Bit.
136,387	.....	.....	20,845	13,428	....	23.8	Buxton, Iowa, Bit.

The results of these tests show that the better of these low-grade fuels can be used, and, in fact, they are today being used over those divisions of the roads where length of haul of bituminous coal makes it too expensive or otherwise inadvisable to use the latter fuel. The use of oil, however, has so many advantages that it will usually displace any solid fuel whenever the cost of oil is low enough to keep the fuel item in operating expense near to what it would be with coal used on the road. This substitution of oil for coal has to a considerable extent taken place in the Wyoming territory since the development of the oil fields in that state.

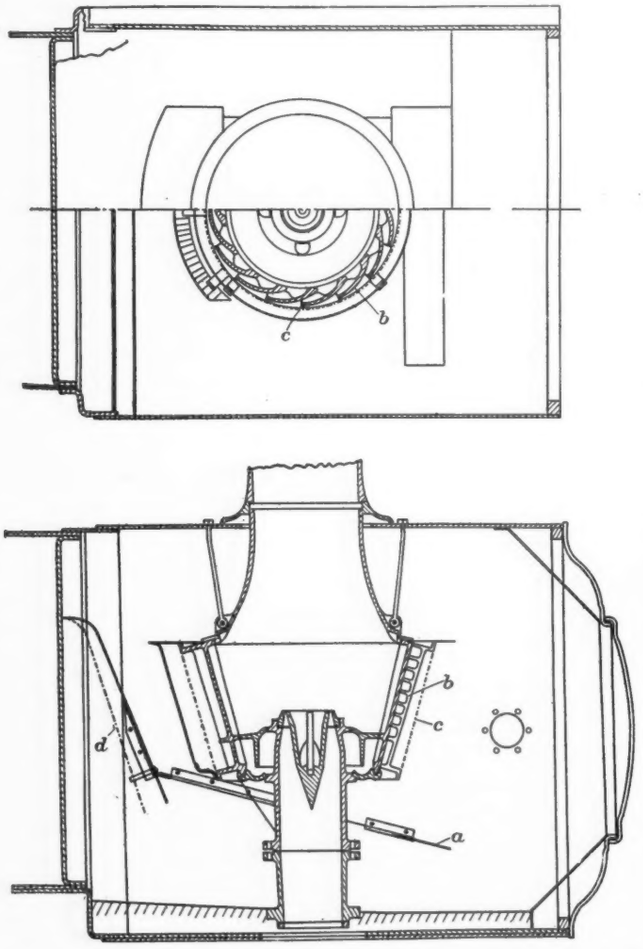


Fig. 4—Gyrus Spark Arrester; a Successful Front-End for Burning Lignite.

As to the future use of these coals, there seems to be no question but that they will be used in increasing quantities. There is doubtless much to learn yet relative to the proper grate area to heating surface ratios that will give best results with different coals. Some of the lines which are today using this sub-bituminous fuel are using it on the same engines that at other times burn bituminous coal. It is possible that it may sometimes be found of sufficient advantage to build all the locomotives which are to be fired with the lower grade fuels with special reference to obtaining the best results from them.

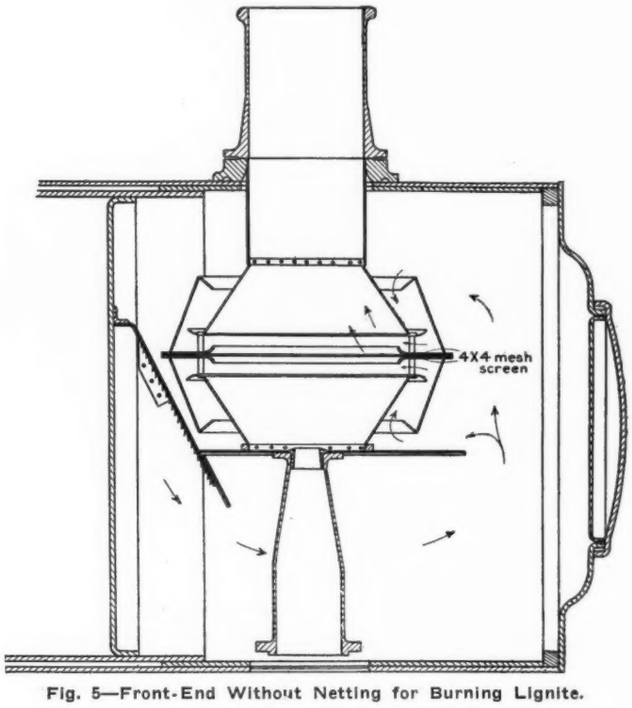


Fig. 5—Front-End Without Netting for Burning Lignite.

The probability of a marked increase in the use of the true lignites in the near future is believed to be not great. The present undeveloped condition of the parts of the country in which the lignites are found, their low heating value, and the availability of the better sub-bituminous coals are all factors that will check the increased use of lignitic coals for steaming, and particularly for locomotive purposes.

Committee—Samuel B. Flagg, chairman; S. C. Graham, J. H. Grove and O. N. Terry.

DISCUSSION.

It appeared that the Chicago & North Western is not using brick arches on lignite burning locomotives and that the Chicago, Burlington & Quincy is using them in practically the same district. No explanation was forthcoming as to the reason for this variation in practice, except it was suggested that the C. & N. W. engines have a smaller ratio of cylinder volume to heating surface. On the basis of stationary boiler practice it seemed that the arch should be used with this form of fuel.

The possibility of briquetting lignitic coals was considered and appeared to be a future possibility. It developed that American-made briquetting machines were now available that would do as satisfactory work as the foreign machines. The trials of making lignite briquettes without a binder were reported as a failure.

The design of the grates to give plenty of air opening is an

important feature in burning lignite. The ash pans must be air tight at the bottom and the air openings in the side must be covered by a fine netting. The locomotives built especially for burning lignite on the Chicago & North Western have a grate 50 per cent. larger than normal. These worked well from the start as regards steaming, but threw many sparks. The application of the apparatus termed a gyrus, as illustrated in the report, cured the trouble. Twenty-one engines of this design are now in successful service.

CONSTRUCTION AND OPERATION OF A BITUMINOUS COAL MINE

J. A. Garcia, of the Allen & Garcia Company, Chicago, presented an extensive and interesting paper on the above subject. He pointed out that the natural conditions, both on the surface and under the ground, are different in each coal field, and that each requires special consideration. A year or more is required for the study and design of a new mine before it is actually under way, and the mine should be constructed in accordance with carefully prepared drawings made and approved by men skilled in both the technical and practical sides of coal mining. A coal mine should be built in accordance with plans and specifications in every particular, in the same way as a large commercial structure would be erected. It is common practice in the bituminous section to figure an average extraction of 1,000 tons per foot of vein per acre, which is approximately 56 per cent. of the coal in place. The author believes, however, that the extraction should reach 75 per cent., and he presented a table showing the percentage and the number of tons extracted per foot per acre for different thicknesses of coal veins. The more important provisions of the mining laws were mentioned, and each step in the construction of a modern coal mine was taken up in detail. Both photographic views and line drawings were freely used and costs were given wherever possible.

DISCUSSION.

Some of the factors causing the increase in the cost of bituminous coal were pointed out by the several members speaking on this subject. The ability and quality of the miners themselves was mentioned. Formerly miners were trained from childhood, but now untrained labor of all kinds has to be used. The Illinois mining laws were claimed to be the best in the country, but it appeared that the better the law the greater the expense to the coal operator. The value of the surface of the ground, which must be protected by leaving much of the coal in the mine, was another feature. It is impossible under present conditions for the operator to control the quality of coal loaded in the mine. He must take and pay for whatever the miners load. It was suggested that a law to make the miners a party to the conservation movement would be a good thing.

The value of the mine rescue campaign was indicated by the fact that there had not been an explosion in a mine in Illinois in over three years. This is largely due to educational methods and improvements in the arrangements in the mines. Further extension of the educational movement and attention to the social welfare of the miners was suggested by Mr. McAuliffe, general coal agent, St. Louis & San Francisco.

FIRING PRACTICE.

The report of the committee on this subject was taken up by sections and action taken on each as shown below. The committee consisted of D. C. Buell, chairman; T. E. Adams, W. C. Hayes and A. N. Willsie.

FIRING TOOLS.

In each case the committee was requested to supply a drawing showing the recommended form of tools with its report next year.

Shovel.—A shovel holding from 14 to 15 lbs. of bituminous coal and with long or short handle, as suited to the fireman and conditions on the locomotive, was recommended.

Coal Pick.—A suitable coal pick, best suited to the requirements of the railroad, shall be provided.

Rakes.—There was considerable discussion on the advisability of supplying a rake on locomotives, but finally the committee's recommendation as given below was adopted: "It is poor practice to rake the fire. The committee hesitates to make a recommendation concerning rakes on locomotives for the purpose of raking fires, although it will probably be some time before firemen can be educated to a point where it will not be necessary to equip engines with some kind of a rake. The committee believes it pertinent to state that a good fireman does not need a rake and does not use one."

Slice Bars.—Length and size should be governed by the particular locomotive on which the slice bar is to be used, and according to whether the dump-grate is in the front or the back of the fire-box.

Shaker Bars.—The committee recommended a pin-connected removable bar where permanent bars could not be applied. The discussion developed that this was not the best design and the matter was referred back for further consideration by the committee.

Care of Firing Tools.—The association recommended that, where practicable, a place should be provided where each fireman can store, under lock, his firing tools, such as shovel, coal pick, etc.

Manipulation of Grates.—Should it be necessary to shake the grates at all they should be shaken only while the throttle is shut off, or while the engine is standing still, and then very lightly. With coal low in ash, and first-class management, it is not necessary to move the grates on the entire trip over the division.

Draft Appliances and Blower.—Careful attention to the tightness of the front end, the cleaning of the front end of cinders, the very moderate use of the blower, and care to prevent the fire burning down while on a side track and then turning on the blower, a practice which is sure to cause leaky flues, were the recommendations adopted.

Flues.—Flues should be kept clean and flue clinker should be knocked off the flue sheet whenever it forms. This is especially important on many types of superheater engines.

HAND FIRING.

Preparation of Coal.—The coal should be broken to firing size before being placed on the tank of the engine. If this is not done, all lumps larger than a man's fist should be broken by the fireman before firing. If necessary to wet down coal on account of dust, only enough water should be used to lay the dust. With very fine coal, better results can sometimes be obtained by wetting the coal enough to hold it together until it strikes the fire and cakes or cokes. The operation of mechanical coal-chutes should be watched, to see that the chute is not delivering all lumps to one engine and all slack to another.

Systems of Firing.—The recommendations of the committee were as follows: Instruct firemen to carry a light fire, a level fire, and a bright fire. Coal should be supplied to the fire in small quantities at frequent intervals. On the larger locomotives not over three or four medium-sized scoops per fire are required to produce the best results. The fire-door should be closed after each scoopful is fired. The coal should be spread on the fire to cover the bright spots, and only enough should be added to take care of the needs of the run.

There was some discussion on the advantage of closing the fire-door between each scoopful. The evidence, however, was most conclusive in favor of the practice. As an example that it was not an undue hardship on the fireman, the results of tests made for evidence before the board of arbitration on firemen's wages were quoted. These showed that the fireman was working on an average of but 25 per cent. of the time, on hard runs. Tests made on runs where the door was closed between each scoopful and another where it was not were reported. These

showed a saving of four or five tons on a trip of a freight train when the door was closed.

Grade of Coal.—As far as possible, coal of uniform quality should be supplied to engines, so that the firemen can familiarize themselves with the grade furnished, and regulate their firing to get the best results with that particular kind of coal. When various kinds of coal are being supplied the engines must be drafted to successfully burn the poorest grade.

Prevention of Smoke.—Careful firing and co-operation between engineer and fireman will prevent practically all smoke. Undue use of the blower should be avoided. Smoke-prevention devices are not necessary except under special conditions, such as on suburban engines, switch engines in terminal territory, etc.

Prevention of Clinkers.—Prevention of clinkers is best obtained by careful preparation of the fire before the trip, and by careful firing on the trip. The fire must be clean to start with. Banks should not be allowed to form in the fire, and the less the grates are shaken the less liability there is of forming clinkers. Hooking or raking a fire breeds clinkers in it. If clinkers start to form in the fire, moderate shaking of the grates with sharp, quick jerks has a tendency to break up the clinker formation.

Prevention of Popping.—Careful firing, and co-operation between the engineer and fireman, are required to prevent the engine from popping. With a light train, or on easy parts of a run, it is recommended that ten pounds less than the full boiler pressure be carried to avoid popping.

Prevention of Leaky Flues.—Careful firing is the best preventative. The fireman should understand the supreme importance of keeping a good fire up against the flue-sheet and of firing so carefully that there will be no danger of holes forming in the fire. The practice of letting fires die out on side-tracks should be discouraged.

Prevention of Engine Failures.—Have a clean boiler, clean flues, and clean fire. Have the engine properly drafted. Provide a fair grade of coal, and have the fireman trained to fire it according to correct principles. Under these conditions, co-operation between the engineer and fireman will prevent a large majority of the engine failures due to steam trouble.

MECHANICAL STOKING.

Preparation of Coal.—Specially prepared stoker coal, if required by the type of stoker in use, should be kept on hand so that it can be regularly furnished to engines equipped with stokers. This refers to coal broken to the proper size to be used by the stoker without crushing on the engine.

Manipulation of the Stoker.—The report made recommendations in connection with some difficulties that had developed in the handling of the underfeed type stoker. It was explained, however, that changes in the design had remedied the trouble and thus this section of the report was not accepted.

Keeping an Even Fire.—It was recommended that care be taken to maintain the adjustment of the stokers. One member reported that considerably less experience was required for a fireman to keep an even fire with a stoker than with hand firing.

Hand Firing.—The report made no definite recommendations on this point. One of the speakers told of a stoker that had been giving 100 per cent. firing for nine months.

EDUCATION OF FIREMEN.

Breaking in New Firemen.—A school for new firemen, conducted at a central point on each road, through which all men must pass before being assigned to regular work, is practicable, and the committee expects to see it largely in use in the near future. Pending this time it was recommended that new firemen be broken in personally by the traveling fireman, if there is such a man on the division; or, if not, by the road foreman of engines.

Traveling Firemen.—The report favored the use of traveling firemen who should be provided with counters to check the fuel consumption. Several members were opposed to having this grade, preferring to use traveling engineers for this purpose, since they could be in full authority while on the locomotive. The combination of traveling firemen and traveling engineers working together had been most successful on some roads. The recommendations of the committee were carried.

Books and Pamphlets.—The committee recommended the progressive examination as a means of promoting study, the firemen being given their instruction books with the understanding that they will be examined after they have been in the service for a certain period.

Combustion Lectures.—The ordinary lectures on fuel economy are of value only when they are followed up by road supervision and instruction. This conclusion was adopted after some discussion.

Moving Pictures.—The report stated that experience on several roads that have used the moving pictures and other illustrations on fuel economy has demonstrated this means to be the best devised for interesting firemen in this important subject. Astonishing results have been obtained and great interest manifested. The method is strongly recommended. This was accepted.

Waste of Coal.—Complete instructions to a fireman to prevent the waste of coal were included in the report. These included a number of features in addition to the direct manipulation of the fire itself. These were adopted.

The last section of the report included a discussion on the best methods of obtaining the fireman's co-operation to prevent waste of fuel. These were largely along the line of a proper appreciation of his responsibilities and a proper method of instruction at the beginning.

MODERN LOCOMOTIVE COALING STATION

A typical coaling station for the southern states would hardly fit the conditions of the climate of the northern states and Canada, but it is believed that there are certain prevailing and dominant factors that will have to be carefully considered for almost any local condition, and having this in mind, it would not be the thought nor the intention to consider climatic conditions as affecting the recommendations.

Wherever it can be accomplished without too great an expense, modern coaling stations should not be located at the large centers of population. In fact, it is believed that it will always prove economical to locate coaling stations away from terminals a distance equal to that which can be covered by one locomotive tank supply, and that no engines, except possibly one or two fast passenger engines, be coaled at the larger terminals. This conclusion is reached after carefully considering the delay and cost due to stopping passenger trains en route for coaling purposes, and also after giving due consideration to the desirability of having all of the motive power activities of a division consolidated under one general supervision. Like all other rules, this one has its exceptions. It would not be economical to so locate a coaling station, where the fuel was being delivered at the terminal in question, that it would mean dead haul of loads and empties for double the distance between the terminal and the coaling station. Grade conditions, density and directions of traffic, junction points and location of supply are all additional factors for careful consideration.

It is believed that the most elastic temporary or emergency coaling plant that can be established is the locomotive crane, and this is particularly so where property values are excessively high, and where it is desired to store an emergency supply on the ground from time to time. In fact, there are some who advocate this method of handling locomotive fuel at all points and under all conditions.

Answers to a circular sent to the members indicated a preference for the trestle type of station where there is sufficient room for the construction of the incline approach, but naturally the cost of property in the larger terminals would materially offset any advantage that might be claimed. Some favor this type

for large stations, handling 10,000 tons or more per month, and where not more than two tracks are to be served. Storage of coal with this type, except such as may be provided through the medium of the pockets and the road cars, is practically prohibitory, due to the additional initial cost.

The balanced bucket mechanical station was recommended in a majority of the replies for locations where the space is restricted and where two or more tracks are to be served. This type is particularly favored for large stations serving 50 or more locomotives, and, in fact, for any service calling for an issue of 100 or more tons of coal daily. As this type calls for the installation of considerable machinery, due care should be given its permanent location so that it will not be disturbed by future improvements.

The bucket conveyor type was favored by some for use at the larger stations where two or more tracks are to be used.

A number of members recommended the locomotive crane and clam-shell for the smaller stations, and for temporary use where the larger plant cannot be permanently located. This type is favored as being very flexible in its use in any class of road cars, and its adaptability to many purposes at any point on the railroad.

Wooden structures were favored for small plants and where they are isolated from other buildings and where first cost is an important element. Steel is recommended in preference to frame or concrete where fireproof construction is desirable, and where there is any possibility that the tracks may be altered at some future time, requiring the moving of the plant. All steel that comes in contact with the coal should be protected by concrete. Concrete is favored, where the cost is not prohibitive, for use in all mechanical plants that are permanently located.

A combination of frame, steel and reinforced concrete would appear to be economical and safe for the trestle type. The trestle approach should be of creosoted timbers on concrete piers. Framing of supports under bins, hoppers and general structure to be of steel. Bins and any other parts coming in contact with the coal to be reinforced concrete slabs. The same general method of construction could be used for the other types, omitting the frame approaches.

In connection with the pocket capacity recommended for 24 hours' service for various numbers of locomotives from 10 to 200 the replies received were wide enough to cover almost any condition. The majority favored from 6 to 10 tons capacity to each locomotive handled.

An operator should not be required to look after more than one plant, particularly where he is required to secure the coal tickets from the enginemen; but it is believed that all of the work of hoisting coal should be so arranged that no night work need be required.

As a general rule the storage of coal is not recommended, except to temporarily and locally overcome local or general failures of transportation, or mining, or on account of possible car shortage. The general objection was the deterioration of the heat values.

One reply favored storing a supply in summer for winter use for the following reasons: To have the equipment which would otherwise be in use in company coal service available for revenue coal service. It is economical to haul as much as possible in warm weather. To give the mine operators every opportunity to sell all commercial coal possible at the period when the highest prices are obtainable. To increase the operators' summer orders with the result that they can hold their miners through the summer, and be ready to put out a large winter tonnage. For economy of purchase, as summer storage coal could usually be purchased at a lower price than coal purchased under a contract with a maximum twice the minimum, and orders even running below the minimum in summer.

The proper elevating capacity per hour for pockets from 50 to 600 tons capacity appears to be that which will fill the pockets in about 5 hours. Replies on this feature varied widely and gave recommendations from one to ten hours to fill the pockets.

[Replies on the cost of operation and maintenance were quoted at some length in the report. They were not, however, in sufficient number or based on conditions that will permit a general or average cost to be obtained. The report to the next convention will tabulate this data.—Ed.]

Eight out of eighteen replies are opposed to any attempts to weigh coal to each locomotive, whereas six replies are in favor; three qualified replies have been received and are in the affirmative, if the weighing appliances are practicable and reliable, and records are kept and followed with each individual locomotive and each individual locomotive engineman.

It is the general recommendation to arbitrarily proportion any and all shrinkage losses to all locomotives in each class of service. One member recommends that no adjustment be made and that losses be prorated to the various classes of service by the auditor.

Opinions naturally differ, as much as the character of coal varies, but it is agreed that there must be more or less depreciation due to the coal passing through the handling plant, which can be corrected to a certain extent by breaking the fall through deflectors, spirals or by some other mechanical devices.

Considerable difficulty is experienced, due to coal becoming separated, lump coal from fine coal, resulting in the coal sticking in the pockets, or a poor distribution of coal to locomotives, although four of the replies would indicate none. Handling coal by buckets and belt conveyors appears to present the greatest difficulties.

It is recommended that the cut-off gates releasing the coal be opened full whenever a tank of coal is discharged. If bins and pockets are kept full, and coal is dumped directly over the outlets, much of the trouble will be obviated. It may sometimes be advisable to provide additional outlets with aprons to correct the matter.

The locomotive crane equipped with clam shell is not looked upon with favor as a competitor of the modern coaling station, and its use should be confined to temporary and emergency service only.

Committee—Hiram J. Slifer, chairman; E. A. Averill, E. E. Barrett, W. E. Dunham, G. W. Freeland, W. T. Krausch, and R. A. Ogle.

DISCUSSION.

Breakage of coal in passing through a mechanical coaling station was claimed to be a serious objection to that general type. Tests had shown an increase in the proportion of slack from 25 per cent. to over 60 per cent. after passing through a balanced bucket station. The trestle type of station was generally favored where there is room for its installation.

One member would guarantee a saving of 10 per cent. if he could have an accurate individual coal record. The Santa Fe is using many stations equipped with weighing hoppers with great success.

SCALING OF LOCOMOTIVE BOILERS

Statistics from the United States government experts on the cost of generating horse power in steam boilers show that to produce 100 horse power for 3,000 working hours, price of coal at $1.50 per ton, and with absolutely clean flues and boiler, would cost $1,269.99; with scale 1/16 in. thick, the same length of time, would mean $1,459, an increase of 14.88 per cent.; with scale ¼ in. thick, $2,030, an increase of 59.84 per cent.; with scale ½ in. thick, $3,173.50, an increase of 71.14 per cent.

We would expect a greater comparative increase in cost or heat loss resulting from varying thicknesses of scale. Instead, we find that with the 700 per cent. increase of the scale (from 1/16 in.) we have a 71 per cent. increase in cost only.

Dr. Joseph G. Rodgers has placed the conductivity of iron to that of boiler scale as 1 to 37.5. If this is so, and scale perfectly tight, the thickness of a boiler tube being ⅛ in., from the above figures it would cost approximately $47,625 to generate the 100 horse power through the tubes, instead of $1,649. Through the

firebox, the plates and scale each being ½ in. thick, would cost the same, instead of $3,173.50, as shown above.

While this is but a rough comparison the differences are startling enough to cause a question.

The amount of data available on the scale question is small indeed. In endeavoring to collect this important information it was found that railroads had nothing to offer. This indicates either that railroads are negligent or that the bugbear of scale, in some minds at least, is to a certain extent, imaginary.

It should not be understood that the committee believes no ill effects result from scale. There can be no doubt of a loss of heat. It, however, believes such loss is overestimated.

Say that a new engine goes on a run of 130 miles and consumes 12 tons of coal. If, after several months have elapsed and a scale 1/16 in. has formed, according to the above data, it would require 13.8 tons to do the same work; or if a ¼ in. scale has formed it would require 19.2 tons. We do not know of any case where this difference in coal consumption has occurred, but ¼ in. boiler scale is common.

On account of the more general introduction of water tubes, it seems advisable at this time to call attention to the necessity for great care and that most rigid inspection to be given them. Convenient and accessible plugs should be supplied. Some competent employee should inspect these tubes after the boiler is washed, and before any of the plugs have been replaced. Inasmuch as these tubes are located in the hottest part of the firebox and the generation of steam is consequently rapid, failure of a badly scaled tube may be expected.

It is believed that the present arch tube is of a diameter too small to adequately take care of the steam generated therein, and it is recommended that the size be increased to an internal diameter of at least 3½ in. This will mean a heavier tube and one stronger on account of the less ratio between diameter and length.

Careless boiler washing has considerable to do with a locomotive's performance. Some steps should be taken to provide a better class of labor for this work. The money usually paid is such that it is not attractive. On many roads it will be found that the boiler washer fails to remove all the plugs. Each plug should be removed and after the washing is completed the boiler should be carefully candled by an inspector.

This first step in the fight against scale can easily be taken by everyone. Scale forming ingredients can be removed from water. The ideal way is to treat the water in settling tanks so that it is commercially pure before its entrance into the boiler. This is expensive and in order to avoid the required outlay some roads use soda ash, the fireman throwing a predetermined amount into the tank each time water is taken. This is improper because the compound is sometimes added to a water already containing an excessive amount of the same ingredient and which is causing trouble from foaming. Too much or too little may be added, therefore each treatment should be chemically correct and the hit-or-miss method avoided wherever possible.

We are strongly of the opinion that pure amorphous graphite will be of material benefit to any boiler. It is purely mechanical in its action, will readily adhere to plates and tubes, and being adhered will prevent anything further sticking thereto. It has a tendency to act upon scale, already formed, by penetrating into the cracks and even into the scale itself. It will render such scale softer and will eventually cause it to fall away from the surfaces.

Committee—J. S. Sheafe, chairman; F. W. Foltz, F. A. Moreland, Harry Bentley, and W. T. Ray.

A supplement to the report gave an outline of the work soon to be undertaken by Henry Kreisinger, U. S. Bureau of Mines, in connection with experiments on the transmission of heat into steam boilers. This work will likely be the first extremely accurate testing done under such conditions as to permit accurate and indubitable determination of the harmful effects of scale and soot.

These investigations will consist of a large number of tests made on specially designed horizontal multi-tubular boilers. The object of the investigations will be to study the laws governing heat transmission primarily, and to gather any incidental data as to the effect of scale and soot accurately. The first set of several hundred tests will be made with four horizontal multi-tubular boilers having lengths of five, ten, fifteen and twenty feet each. Each boiler will be equipped with several sizes of tubes successively ranging from three-quarters of an inch to four inches in internal diameter. Each of these boilers will be fed with gas heated by burning natural gas or petroleum, to various temperatures ranging from 1,000 to 2,250 degrees, in steps of 250 degrees Fahrenheit. It is planned at present to investigate the following factors: The effect of velocity of gas through tubes; the effect of initial temperature of gas; the effect of the steam pressure in the boiler; the effect of the different diameters of tubes; the effect of the different lengths of tubes; the effect of conductivity of the tube metal (both iron and copper tubes will be used at different times); the effect of scale on the water side of the tubes, and the effect of a coating of soot on the gas side of the tubes.

Drawings were included showing the arrangement of the apparatus to be used in these tests.

DISCUSSION.

It appeared that a decided loss of fuel could be attributed to boiler scale, and that there seemed to be little difference noticed in this respect with variation in the character of the deposit. Boiler compounds and graphite were reported to be successful in removing it, but care must be used in the use of the former, as cases of pitting had resulted from excessive amounts. The deposit of soot on the inside of the firebox and tubes was believed by some of the speakers to be of more harm than the scale. Where compounds or soda ash are used in comparatively large quantities, frequent blowing-down periods of short duration are good practice. Cases were reported where the blow-off cocks were opened from 3 to 5 seconds in every 1 to 3 miles. Larger arch tubes were favored by several of the speakers.

OTHER BUSINESS

Self-Propelled Cars.—An extensive report on this subject was presented and will be found in abstract in the Car Department section of this issue.

Election of Officers.—The following officers were elected for the ensuing year: President, R. Collett, superintendent locomotive fuel service, St. Louis & San Francisco; vice-presidents, D. B. Sebastian, fuel agent, Chicago, Rock Island & Pacific, and D. C. Buell, chief of the educational bureau, Union Pacific. Executive members for two years: B. P. Phillippe, coal agent, Pennsylvania Railroad; C. F. Ludington, chief fuel supervisor, Atchison, Topeka & Santa Fe; J. S. Sheafe, engineer of tests, Illinois Central, and F. F. Gaines, superintendent of motive power, Central of Georgia. For one year: E. McAuliffe, general coal agent, St. Louis & San Francisco, and W. H. Averell, superintendent, Staten Island Lines, Baltimore & Ohio.

The Slipping of Belts.—Driving belts, states a contemporary, often undergo improper treatment. If they fail in their work by slipping over the pulley without driving it, what is usually resorted to is rosin, which is a good help for the time being but is sure to spoil the belt by making it rough and brittle. In a dusty room an emery like mixture is formed by the dust and the rosin which rubs away the belt.—*The Engineer.*

Turning Driving Box Brasses on a Boring Mill.—At the Norfolk & Western roundhouse at West Roanoke, Va., a boring mill is used for turning the box fit on driving box brasses. The brass is held in place by a semi-circular cast iron plate placed on top of it and held by a bolt and nut. By using the boring mill a brass may be quite readily set up and turned complete in the time which it would take to set it up in a lathe.

RAILWAY STOREKEEPERS' ASSOCIATION

Abstracts of the Papers and Outlines of the Discussions at the Tenth Annual Convention.

About 275 members registered at the tenth annual convention of the Railway Storekeepers' Association at the Hotel Sherman, Chicago, May 19-21. After prayer by Rev. William E. Barton, of Oak Park, President J. R. Mulroy, general storekeeper of the Pullman Company, called on E. Chamberlain, manager equipment clearing house, New York Central Lines, to address the meeting. Mr. Chamberlain drew attention to the growing importance of the storekeeper's position.

President Mulroy, in his address, drew attention to the past work of the association, stating that it had been of great benefit in raising the standard of the whole purchasing and supply department. He complimented the membership committee on its work, which had resulted in an increase of about 150 in the membership during the year.

G. G. Yeomans was called on to speak and presented some striking statistics on the value of the material held in stock on the railways. He urged the members to follow closely the recommendations of the association. If they did not agree with them, the floor of the convention is the place to voice their objections.

The secretary-treasurer's report showed that the membership was 744. The balance in the treasury is $886.81.

The committee on piece-work reported that its investigation indicated the piece-work system to be the best and most efficient wherever the conditions permitted its use. One of the members in charge of a large creosoting plant stated that 90 per cent. of his force worked on piece-work, with a decrease of 25 to 40 per cent. in the operating cost. The men get high wages and he considers the highest paid man the cheapest for the company.

INACTIVE AND OBSOLETE STOCKS

BY E. J. ROTH, C. B. & Q.

All obsolete stocks are inactive, but of course all inactive stocks are not composed entirely of obsolete material. If they were, the proposition would be comparatively simple. It should pass without question that the thing to do with obsolete material is to scrap it and utilize the scrap to the best possible advantage. The loss due to the difference between the value of the scrap material and the manufactured product in many cases is small. Obsolete forgings can usually be worked over in a blacksmith shop into standard articles with a slight loss. The value of scrap brass is not much less than that of the manufactured product. The loss is greater, of course, in case of iron and steel castings and other similar articles, but even then there is nothing to be gained in carrying year after year as an asset, with resultant handling, interest charges, taxation, etc., material which cannot be used and which has a real and intrinsic value only as scrap.

In our experience the most effective remedies for reducing inactive stocks in storehouses and material yards have been:

First—Maintain stock books at all points where material is carried, whether this is directly in charge of a representative of the store department or of some other department.

Second—List all material of all kinds in the stock book.

Third—Carefully check the stock book to determine material that is surplus.

Fourth—Send with orders from division or district stores to the general storekeeper stock books or their copies and stock lists. Stock lists with a description of the material printed on them, containing information as to material on hand, due, ordered current year, ordered past year and surplus, if any, have seemed the better practice. This leaves the stock book in the hands of the stock man where it belongs, and the printing of the description of the material on the stock lists insures the material being listed on all reports to the general storekeeper in the same order and facilitates checking them with the orders in the general storekeeper's office. One of the other large railroads in the middle west is putting into effect a plan which appears very efficient and economical. Their storekeeper's stock book is printed in duplicate, two sheets being placed together, which are exactly alike except that the bottom sheet has perforations separating the entries for each month. A carbon sheet is placed between the sheets when stock is taken and after all the information has been filled in, the carbon copy is torn off at the perforations. These carbon copies for material in each classification are sent to the office of the general storekeeper where they are pasted in a printed stock book, a duplicate of the one which the storekeepers have. The slips from each store are identified by classification and page number and placed in the general storekeeper's stock book next to corresponding slips from other stores opposite the items they cover. This gives the general storekeeper a complete stock book for the entire line with very little if any additional work.

Fifth—When making orders the storekeeper should consult frequently and freely with responsible officers in the departments using the material ordered for stock as well as for special work.

Sixth—Assemble surplus material as far as practical at the general or distributing store, where it is readily available for use at any point where needed, storing it with other material of similar kind so that it will be constantly before the stock man and may be used by him at every opportunity in filling orders—frequently by substitution, this always with the consent of the party ordering.

Seventh—Where surplus material is of such a character or conditions are such that it would entail unnecessary expense to move this to the general or distributing store, a special report to the general storekeeper or the general or distributing store of all such material with complete descriptions, etc., should be made.

Eighth—Advertise surplus material among the departments which might be able to use it. On this I wish to lay particular stress. We have found that with the knowledge which they get, from the periodical reports we make them, of engines, pumps, boilers, large pipe, second hand lumber, brick, track material, etc., etc., on hand, the engineering, operating, mechanical and bridge and building departments are frequently able to arrange their plans for work to use such material instead of purchasing new. The storekeeper must have a knowledge of the purpose for which such material was originally purchased or can best be used and bend his energies in directing toward it the attention of the men who order material for this particular kind of work.

Ninth—A surplus committee composed of practical men from the mechanical, engineering and store departments, periodically visits each storehouse and material yard, going over the stock in detail with the storekeeper and his stockmen, considering all surplus material of all kinds whether obsolete or not and authorizing scrapping of obsolete material or surplus material where, upon thorough investigation, this is found advisable. Where the character of the material is such that the difference between the value of scrap and the manufactured product is small, it is frequently found advisable to scrap material of which there is so large a surplus that there is no chance of it being used within a reasonable time.

Local representatives of the departments who use the material of the class being considered assist the surplus committee in its deliberations. These local men are usually foremen, who by their work with the committee, become more familiar with the storekeeper's stock than they otherwise would and are fre-

quently able to arrange for substitution and use up surplus material which would otherwise remain on hand indefinitely.

Possibly the most important feature of our present plan is that of working closely with the departments who use the material. This accounts for a great deal of what success we have had. The storekeeper who can keep closely enough informed as to market conditions affecting time of delivery of material, and so gage his estimates of future requirements that he will not order and receive more material than he actually requires, will not have to worry much about inactive stocks.

BY H. A. ANDERSON, PENNSYLVANIA.

In determining what amounts shall be reported as surplus, care must be exercised to consider the issues of preceding months, and in the case of "seasonal" material, to issues during a corresponding period of the previous season. In addition, it is also essential that consideration be given the amount of stock permitted to be carried on hand, and the length of time required in which to replenish the stock by requisitions on manufacturers. After deciding on surplus items, a list should be prepared and forwarded to the officer responsible, for the transfer of such material. This list should include, for each item reported, the quantity to be disposed of, complete description with pattern and tracing numbers and the unit price. In fact, on this list the information should be in the order, and as complete as would be required in the making of a requisition for the same item. The list should be checked by the purchasing agent, or general storekeeper, with all requisitions calling for the purchase of material.

These reports should also show the number of months each item has been so reported. This information would be the means for a ready reference to material that should receive special attention. For any material appearing on this list continuously for a period of twelve months, there would seem to be little need. While exceptions to this general rule would be noted, at the expiration of the twelve months' period each item so appearing should be separately considered, to determine the advisability of continuing to show it available for transfer or making final disposition of it.

Inactive and obsolete material is that for which there is no further demand. Its accumulation has been brought about chiefly through the release of equipment, changes in design and standards and to reclaiming from the scrap of items without regard to requirements. There is little that can be done in the case of this material, lacking authority or ability to disburse the old standards, until exhaustion of the stock, but to consign it to the scrap pile. The proper course would be to make disposition immediately upon the appearance of the inactive items. It has been found, however, that the mechanical and roadway departments are loath to take what they term hasty action in these cases, with the result that material is often continued in stock for an indefinite period.

Having considered the disposition of an item after being reported as surplus for twelve months, and deciding to prolong its existence, except where, during such period, there may have been call for the article, it is thought that such item should be discontinued on the surplus list and included on the list of inactive and obsolete material. This inactive list should contain the same information as the surplus list, except that the entire stock, as a rule, should be shown. It should be necessary that its listing among the inactive items be continued only three or four months before again being considered for final disposition. This last attention should be given jointly by the representatives of the operating and stores departments, and, lacking visible use for the material, it should be scrapped and the difference between the carrying and scrap values debited to the expense account to which the material would have been charged, had it been actually used. In so disposing of either surplus or inactive material, particularly on the larger systems, it is likely that a small quantity of more or less serviceable material will be scrapped, but it is inconceivable that such seeming waste can total in money value the expense incurred by perpetuating the material in stock, considering the interest on investment and the clerical labor involved in handling and in monthly accounting for and reporting such items.

In connection with the lists which have been mentioned, it would be well to state that these would seem hardly necessary when the railroad is operating under the general storehouse plan. To such storehouses, we presume, would naturally be shipped all surplus and inactive material and the final disposition of it would be decided there. On a road which has no general storehouse these lists are essential, and we endeavor to scrap the material at the carrying point, except in the case of small outlying points, where knowledge of system requirements is, as a rule, very meager, in which case it seems well to have it returned to the distributing storehouse.

The question of endeavoring to dispose of material to the manufacturers from whom it was originally purchased has received careful attention, but the results in such cases have been so doubtful, considering the expense of packing and shipping. as to indicate that the interests of the railroad can best be served by handling the material as indicated above.

BY W. D. STOKES, ILLINOIS CENTRAL.

The first consideration would seem to be the establishment of some tangible system of interchange between stores, and in order to accomplish this result it is obvious that a knowledge must be had by all interested of the location and amount available. For the sake of rapid consummation, it has been the practice, to some extent, to make up at each division store, periodically, an itemized list of all surplus articles, sending one copy to each of the other stores and to the general store. From this, in lieu of ordering on the general store, requisitions are made between stores and prompt action obtained. In the event that requisitions for material of this nature are for amounts in excess of the surplus, and from more than one storekeeper, it is important that the ordering storekeeper be promptly notified in order that he may make such other arrangements as may be necessary. Where traveling storekeepers, inspectors of stores or other representatives of the department, in constant touch with local conditions, are employed, it is possible to make extensive transfers to advantage, and in this manner minimize the detail materially.

Another plan, apparently ideal for medium sized roads, is to so arrange requisition forms as to show, in addition to amounts on hand, due and ordered, the average monthly consumption and from these the general storekeeper issues what may be termed a general store back-order on division stores, to serve in lieu of orders on the purchasing agent. It would probably add to its efficiency to require stock books to be forwarded with the requisitions, partially as a check, but largely with a view toward having all amounts in surplus designated in the ordered column in red figures, as in this manner an idea could be obtained of all surplus, irrespective of whether appearing on the requisition or not.

An elaboration of the foregoing and possibly the most efficient of any, contemplates all items printed in stock books in order to insure uniformity of order and to have a surplus stock list printed in the same order, arranged to show the amount of surplus of all items, together with the average monthly consumptions and the amount on hand. This gives the general storekeeper an opportunity to size up the situation.

Semi-monthly lists of hard stock, material on hand for work deferred, and the principal items of heavy character on hand, will, if furnished the general storekeeper, oft-times result in movement, in lieu of purchases.

Whatever the method of imparting the information or of working out the details of this proposition, one thing is absolutely imperative, viz.: correct information regarding the amounts on hand and due, as without this precaution no hope can be entertained of intelligently coping with the situation.

Disposition of obsolete material, not contemplated in the foregoing, presents a less complicated problem and is dependent largely on decision, location and amount. By decision is meant the passing by competent operating authority on the items set aside or relieved. It is plainly the duty of the storekeeper to institute an insistent campaign looking toward the desired end, and thereafter the question is simply one of convenience of movement, as having been classified as other than obsolete it no longer can be considered in that light and must be dealt with as hard or slow moving stock.

BY H. STEPHENS, L. S. & M. S.

Mr. Stephens confined his remarks principally to the design and use of maintenance of way department material, and made some suggestions on the best way of handling it through the storehouse.

DISCUSSION.

A number of members spoke favoring, in a general way, the methods advocated by the authors of the papers. The forming of a committee to make recommendations on the disposition of inactive and obsolete stock was reported as being successful. In one case at least, including the chief draftsman on this committee had been an important factor in its success. Local foremen are generally called into consultation with the committee as it travels over the road.

EFFECT OF SPECIFICATIONS AND TESTING OF MATERIAL ON THE STOREKEEPERS' STOCK

BY W. DAVIDSON, ILLINOIS CENTRAL.

Ordering material by specifications will help a storekeeper's stock because the company will get full value for every dollar spent. Purchasing first class material will also bring about a saving in other ways than affecting the stock of the storekeeper. There is more to storekeeping than trying to reduce stock. It is expensive to apply inferior material to equipment. If a company buys material by specifications, in time it will reduce stock, as good material lasts longer and gives better results. The purchases will not be so heavy and when purchases are reduced, the stock will naturally show a decrease.

It is not necessary to make up specifications for all material, but only for such items as lumber, axles, wheels, tires, engine and staybolt iron; common, round and flat iron; brass, malleable, grey and steel castings; rubber goods; firebox, boiler and tank steel; paints, oils, frogs, switches, etc. All of the above material should be inspected at the point of shipment where practical and if not, the requisition should specify "To be inspected at destination." The manufacturer knowing that the material is going to be inspected and must be in accordance with specifications, will undoubtedly see that it meets the requirements. You can readily see that the company using this method of ordering material has an advantage over companies ordering material other than by specifications.

Material not ordered by specifications should be watched by the storekeeper and the department using it should report any inferior articles received. This would keep a check on the engineer of tests or inspector, or whomsoever the company has to inspect the material. The inspector should be required to go over the storekeeper's stock on hand with a view of catching material furnished that is inferior, reporting such articles to the storekeeper, so that he can return them to manufacturers. Ordering material by specifications saves considerable correspondence and relieves the storekeeper and purchasing agent of any criticism.

BY J. S. SHEAFE, ILLINOIS CENTRAL.

The test department should be separated from the purchasing and store departments. As the mechanical department uses the bulk of the stock carried, it is perhaps better for the inspection to come directly under such jurisdiction. Railroads for many years operated with material purchased without specifications and with more or less indifferent inspection. The same could be done today, but the loss to a company would, without doubt, be more than enough to pay for the support of a testing department.

There are so many specifications now in existence that any road may have a complete set by merely copying what has already been printed. It is advisable, however, for each to make its own and to put in, whenever possible, something which will prevent the substitution of poorer material.

On the Illinois Central a specification is blocked out and several copies are sent to the purchasing agent, who submits one to each manufacturer for his criticism. It will always be found that this criticism is forthcoming and from the whole it is possible to fix the high limits of requirements to each of which two or three companies have agreed. If necessary, a revision can be made and again submitted. When finally in shape they are approved and printed and purchases are made to the standard requirements.

A specification should be more than a stereotyped form. It should be as strict as possible but with due regard to commercial practice.

The testing of material is simply the following out of carefully predetermined methods, together with a little judgment or common sense. The arbitrary rejection of a large quantity of material on a technicality should be frowned on, unless it is repeatedly evident that the manufacturer shows no disposition to improve his product, not to the grade the inspector may consider proper, but to that which the better class of his competitors maintain.

Although all chemical laboratory, and some physical laboratory work is more or less technical, yet the constant effort should be towards practical simplicity. Chemical laboratory results are of secondary importance, in many materials tested, to a practical performance or comparison. They are valuable more as a check or as a prophecy as to what the material will or will not accomplish in service. Methods of testing should be towards comparative results. While this is a slow process it is educational. As for the effect on stock of material inspection there is no reason for the store department to suffer any inconvenience in normal times.

BY F. H. HANSON, L. S. & M. S.

There are three predominating methods used in the purchase of material.

Some purchasers adopt the method of purchasing from the lowest bidder in the open market, entirely disregarding the matter of specifications as well as that of tests. Invariably this method involves great sacrifice of quality, which in itself represents loss in so far as the service obtained from the material is concerned, not considering the likelihood of accidents due to the existence of defects not detectable, except by test. This method has proved to be extravagant. While the first cost apparently is low, the subsequent outlay often totals to many times that paid for first class material and its resultant satisfactory service.

As an example; one gallon of pure No. 1 lard oil costs 46 cents, whereas a gallon of adulterated lard oil costs 40 cents. The adulterated product often consists of one-half pure No. 1 lard oil, costing 23 cents, and one-half gallon of refined petroleum at 7 cents, making the total cost of the adulterated oil 30 cents, or a loss of 10 cents to the purchaser, who thinks he is saving 6 cents on the first cost. The fact remains undisputed that the purchaser who does not inspect or test material bought in the open market very often receives material that has been rejected by the purchaser who does inspect or test, or who has his material furnished to specifications. Several months ago the writer observed a case in which a large number of castings were rejected by a railroad company's inspector, and the following day the same lot of castings was shipped to another railroad where no inspection was made. These, and innumerable other cases that might be cited, show the absolute necessity of furnishing

specifications; also, the testing and inspecting of the material.

The second method is that of purchasing only a few brands of material, of long established excellence and reliability. This method, while it is reasonably safe and invariably insures the purchase of good material, is frequently found to be expensive, for while the product might be first class, its cost is greatly in excess of that of material of less popularity, but which might withstand the necessary tests admirably.

The third method is the practice of purchasing on the basis of specifications and the testing and inspecting of all material. The specifications are merely definite statements concerning the kind and quality of material desired. This plan places all bidders on a fair and equal basis, and at the same time protects the manufacturer against unfair, discriminative and unwarranted complaints. He knows what is wanted and the specifications show him what will be accepted. This method of purchasing material is now so generally known and practiced that no supporting argument is necessary in its behalf. The only discussion pertinent to this plan is that treating of the extent to which the system should be carried, and of the details to be employed in its use.

While it is true that material should be of the proper quality at all times, yet the fact remains that certain definite tests and inspections might not always be necessary. Obviously, certain material on which depends the safety of the public and employees, should be regularly and thoroughly examined; likewise material especially liable to physical imperfections or subject to willful adulteration. Conditions, however, must be the governing factor, as at times certain material may demand extremely careful examination of each piece, while later conditions governing the manufacture and sale of a certain product might be improved so markedly as to render this rigid examination unnecessary. On the other hand, the opposite extreme might be true. Material at one time so reliable as to require but little inspection may, by reason of increasing scarcity of that particular commodity, price-cutting, or for other reasons, become adulterated, or embody other physical imperfections, and thus demand the most scrupulous inspection and test.

If material be inspected and tested at destination, then the purchaser must provide the necessary facilities for properly doing the work. On all large roads a laboratory is indispensable, and testing machines of the proper type are essential to the study of the material in service. Roads of medium proportions are but moderately equipped in this respect.

The question of cost, as in any other operation, should be given due consideration, and if the work be systematized, inspection on arrival will involve very little additional labor in the way of handling the material, as this is done while the material is being unloaded. If laboratory tests are to be made, the material should be so stocked as to preserve its identity, if this be necessary in connection with the contemplated tests. Often, however, all desired tests can be completed within a day, in which case the material might be left in the car until tests are completed. This practice is but seldom desirable as rejections occur so rarely that the item of cost incurred in reloading material is a factor so small as to be almost insignificant. If, on the other hand, conditions so shape themselves that rejections become frequent, the purchasing agent invariably withholds orders from the manufacturer furnishing unsatisfactory material and places them with concerns who will deliver the goods.

Careful consideration of all phases of the question of inspection, as it relates to cost, discloses the fact that inspection at the point of manufacture is from two to five times greater than inspection at destination, and this applies to nearly all classes of material.

An inspector at the purchaser's shops or storehouse is kept busy continually while on duty, whereas from actual experience we find that an inspector at the mill is busy not more than 50 per cent. of his time on duty. Coupled to this "dead-time" loss is that of the usual traveling and personal expenses of such inspector, amounting to from 75 per cent. to 100 per cent. of his salary. Further than this, the inspector at the mill is alone and must be fully conversant with and experienced in every branch of the work he touches; he must meet the manufacturer's representatives (each expert in his particular line), and only a thoroughly competent man will be satisfactory. On the other hand, an inspector working in the purchaser's shops is constantly in touch with his superior officer, and, therefore, may be a less experienced and a cheaper employee.

The decision regarding "where to inspect," naturally, must be governed solely by the character of the material to be inspected. Heavy material that may be readily identified, may advantageously be inspected at the mill. For instance, car wheels have individual numbers cast on them, and the receiving storekeeper, by such numbers, can readily identify them as being the wheels inspected and accepted. Likewise, boiler plate, axles, steel castings, and other similar material may easily be stamped with the inspector's special mark, thus indicating acceptance. This scheme of marking, however, is not practicable in the case of small articles, such as rivets, bars of merchant iron, etc. Also, it is impracticable to make analyses outside of the laboratory, consequently it is desirable to inspect on arrival certain materials, such as oils, paints, pig and ingot metals, alloys and similar material that is tested chemically.

The railroads as a whole are beginning to realize the necessity of more uniformity in the drafting of specifications covering material and a considerable saving is sure to result. Recently the Master Car Builders' Association took steps to bring about a more logical arrangement in the matter of specifications, and a revision of its standards and specifications. Other organizations have taken similar action with this end in view, and an effort is being made to combine the railroads under one head as regards the inspection of various classes of material. In many ways the drift of present-day thought toward uniformity in this respect is apparent.

Heretofore the value of specifications has not been generally realized, but the time has come when a grand awakening to their value is in sight. More extensive use of specifications, more adequate and capable inspections and tests, and a building up of mechanical engineering forces are recommended, in order that railroads may avail themselves of the advantages thus offered, and protect themselves against the perils of using imperfect material, and at the same time form a basis of acceptance or rejection.

DISCUSSION.

Inspectors at outside points or an outside bureau of inspectors had been found to be very satisfactory in many instances. The New York Central Lines are considering the forming of a bureau of their own to be located at the principal points of supply to do inspecting for all its lines and also for other roads, if desired.

There was considerable discussion on the proper position of the engineer of tests in the organization. Some speakers believed that this officer should not report to the superintendent of motive power, others favored having him report to the storekeeper. A difference of opinion developed as to the proportion of the test department work that originated with or was returned to the mechanical department.

HANDLING OF ICE

Several papers were presented on the "Proper Method of Storage, Disbursement, Shrinkage and General Handling of Ice on Railroads." The statement was made in one of these that service buildings should be constructed to prevent shrinkage and should be sanitary. Two wheel sanitary cars, painted white, having tight covers, should be provided to handle ice from the service building to the trains. Refrigerator and cream cars should have the doors guarded with canvas curtains when working the car. Cold cars should be kept in continuous service and the use of warm cars prevented as much as possible. Ice for office use should be clean and handled promptly from the storage to the

cooler. The ice should not come in contact with the water, but be put in a separate container and the container put in the water.

In the discussion E. J. Roth, Chicago, Burlington & Quincy, reported that a yearly saving of $50,000 had been made in the handling of ice on that railway since it had been in the storekeepers' department.

EFFECT OF STORES DEPARTMENT ON OPERATING COST

BY N. M. RICE, A. T. & S. F.

The effect of a well-organized store department on the operating cost of a railroad is far-reaching. In their organization the Santa Fe purchasing and stores departments are somewhat different from those of other railroads, in that the head of each reports to the same vice-president, and while to a certain extent each is a separate department in itself, yet at the same time the two departments work in accord; consequently the assistance given by either department to the other brings advantageous results not obtainable otherwise.

Primarily, purchases made of railroad material and supplies, governed by quality and controlled by competitive bids, as well as those items bought under contract, assist very materially in laying the foundation of an economic effect on the operating cost; however, should the effort stop here the surplus and consequent waste thereafter to be encountered would destroy entirely the results thus far obtained.

It is well known that a railroad operating under most favorable circumstances, in so far as management is concerned, will suffer, from a monetary standpoint, from gross errors made in over-estimates of material required in construction of renewals. Then again there is an expensive outlay to meet the demands of new conditions. To reduce the expensive effect of conditions such as these, the store department must keep in touch with the situation and handle through its channels the surplus and out of date material, giving credit to operating accounts, and then by application, by substitution, wherever possible, prevent expenditures proved unnecessary by the acceptance of the substitute. The sources from which reclaims can be made are numerous and embrace items ranging from large and expensive bridge timbers left on the right of way at some bridge to serviceable second-hand track spikes found in the scrap yard, and which when returned to the stock of the store department and the proper operating account receives credit therefor has its effect on reducing operating expenses.

In a great many cases even where full care and caution are used by the heads of the different branches of the operating or constructing department, in figuring estimates and in placing requisitions for material required for some specific work, changes made after the material is on the ground and charged to that particular work, will oftentimes result in several dollars' worth of material being left unused, which if not taken up and turned back to store stock for credit and used elsewhere, will necessarily stand charged to the work for which it was originally ordered, and even though at that particular time it is the intention, at some future date, to use this material in connection with similar work at some other point, the probabilities are when that time arrives, if ever, it will be found that deterioration will prevent, thus necessitating another supply of material and its consequent additional charge. Conditions, however, on the Santa Fe, under which the store department endeavors to make its system effective, practically demand the prompt return of this material to its jurisdiction, and there have been years when the value of material returned to stock, on the entire Santa Fe system, amounted to over $2,250,000, or approximately 6 per cent. of the issues. In these figures, however, are included approximately $420,000 worth of serviceable material reclaimed from scrap.

The mechanical working stock at terminals and shops embraces exactly the same features as the line stock, only it is conducted on a larger scale and carries with it the additional advantage of being located in close proximity to the work for which it is required, thus dispensing with the necessity of mechanical department employees making long trips for material and thus securing their greater application to the work. This principle of handling is in universal practice on practically each and every item of material, the objective point being to prevent charges for material until actually required.

With the practice of issuing supplies and stationery from supply cars, which run monthly, the requisitions are made for thirty day needs only, instead of considering it necessary to carry on hand an extra 30 or 60 days stock for emergency, thus reducing charges to this class of operation, monthly, to a minimum.

One of the many economic effects on operation can be procured in systematizing the storing and distributing of oil. In the first place the cost of the oil is placed at the minimum, when proper storage has been provided therefor, by purchasing for delivery in tank cars. The use of steel tanks for storage and self-registering pumps for delivery eliminates the inevitable attendant loss, not including increase in purchase price, when bought in barrels and issued therefrom through faucets. Practical tests by competent engineers show losses, in the barrel and faucet method of handling, of from 5 to 25 per cent. on lubricating oils and on volatile oils the loss is much greater.

Another source from which the store department can always draw means with which to affect operation is the scrap yard. Each and every ton of scrap picked up on the right of way or at terminals and sent in to the central scrap yard is just that much reduction in charges to operating accounts, and the more care and diligence that are employed in sorting the scrap and in the reclaiming of serviceable material, just that much more benefit will accrue. Brass, of course, is the one item of scrap, which on account of its value, stands out clear and distinct as requiring more care, more diligence in following up, than any other single item. Monthly comparisons of receipts of scrap brass with purchases of new, as well as care in safe storing are essentials, which, if overlooked, play havoc with returns in this class of scrap. When one takes into consideration that the cost of new brass on the Santa Fe System for one year is between $700,000 and $750,000, while the value of scrap brass sold is approximately $500,000, it is needless for me to add anything further to prove the effect on operation by this one item of scrap alone.

Reclamation and utilization of serviceable material taken from scrap has each year broadened and expanded until now practically no item which can be utilized to an advantage is placed on the market for sale. As mentioned heretofore, the value of serviceable material reclaimed from scrap approximates $420,000 yearly, while the sale of scrap, restricted somewhat on account of unsatisfactory market prices, has averaged for the past two years $1,250,000.

An arrangement is in effect on the Santa Fe whereby the store department periodically makes a check of way car equipment, and even though requisitions for this class of supplies are approved by trainmasters and superintendents, it is amazing in how short a time a surplus will accumulate. Just a short while ago a check of 32 cars resulted in the return to stock of $2,291.94 worth of supplies not required, an average of $71.62 per car. The return to stock of these items, of course, affects the operating cost of a railroad.

Fuel is the most expensive single item for which railroads pay and the one single item which can be made the greatest factor in handsome returns to operation. We have on the Santa Fe organized a branch of the store department, which gives its entire attention to this pursuit. If information procured on methods in use on other railroads in connection with handling fuel is correct, the system under which we are operating is decidedly more far-reaching than any other in existence.

It was not until June, 1908, that the store department assumed entire control of fuel handling. It is therefore necessary to use the twelve months following that date as a basis of comparison

for the three fiscal years, ending since June, 1909. While the decrease per ton mile since that time is fairly good, yet as this was the initial year in our efforts to reduce consumption, in view of the success secured since, it is apparent that the decrease from periods prior to June, 1908, for the years following 1909 is really greater than actually appears. The following is the result of the comparison of the fiscal year 1912, years 1910 and 1911 being not so good, but still a considerable decrease from 1909.

Ton miles	29 per cent. increase
Fuel consumed	16.2 per cent. increase
Fuel consumption per ton mile	9.7 per cent. decrease

Or in other words, the efficiency of a ton of coal was raised 9.7 per cent., which, when applied to a $9,500,000 yearly fuel bill, shows the effect on operation in no uncertain terms.

In the face of this decrease, for the first eight months of the fiscal year 1913, due to more rigid supervision, there is a further reduction from the same months of 1912 of $421,438.83. These figures take into consideration increase in purchase price of fuel and are based on the increased efficiency this year over last of a ton of fuel as compared with the increased cost to operation, had the efficiency of the fuel remained stationary or decreased.

BY H. C. PEARCE, SOUTHERN PACIFIC.

The real value of a well-organized and efficient supply department can only be determined by the final results of the operation of the property. Its service should be measured from day to day. The condition of the property under its control shows for itself. The investment is indicated by the balance sheet. The real economy which is effected will be best shown by the percentage of purchases to the issues over a period, with knowledge of conditions.

The supply department should be organized and operated to reduce purchases and not to increase them. The unit of price, unless service and need is considered, is a false one. The real unit is making the most of what you have and making everything give its full measure of usefulness and so handling and disposing of the salvage as to obtain every dollar there is in it, the ultimate purpose of it all being the net cost of materials and not the first cost.

It is to this department that we must look for savings in values, which are otherwise generally overlooked. The dollar is watched, checked and supervised. The same value in material hardly receives a thought. Our railroads must look to their supply departments to protect their materials to the same extent that they now look to their accounting and treasury departments for the protection of their dollars.

The first purpose of a supply department is to supply the needs of the railroad. It must be organized in such a way that what is best suited for the purpose can be laid down promptly at the time it is needed, at the least cost. The saving made by having an organization of this character can never be shown by statistics. It is represented only in the cost of the work.

Its second purpose is to market the salvage. With railroads having their own foundries and rolling mills, the railroad itself is its best customer and salvage should be handled in such a way as to apply it to the requirements of the railroad to the best advantage.

I will not attempt to go into detail as to how the salvage on our railroads should be handled, controlled and marketed. This matter was presented at last year's convention and in an article appearing in the *Railway Age Gazette*, issue of December 13, 1912. I wish to simply point out the one fact that the use and marketing of salvage is of second importance only to the providing and caring for the company's property.

The third purpose of a supply department is to handle its material with the least expense, always taking into consideration the first two principles, i. e., that it is necessary to provide and properly care for what you have.

The fourth purpose is to prevent deterioration and reduce interest on investment, deterioration for want of proper care and housing facilities, system, etc., changes in standards, changes in plans, curtailment of forces, lack of proper facilities and lack of proper care. The losses here are enormous. An efficient organization should be such as to have perfect control and knowledge of every item on hand and on order and the organization should be so conducted as to reduce losses by deterioration, changes in plans, changes in equipment, etc., to the lowest possible basis. Interest on the investment is a big item and one which should be fully considered by any well-organized department, but this is one of the items which is exposed and the management can easily watch and protect this item, and, further, if the other purposes I have mentioned are taken care of, this item will take care of itself.

DISCUSSION.

F. D. Reed, Rock Island Lines, drew attention to the chance of loss through improper supervision or a swollen emergency stock. He favored a centralized storehouse and the handling of all material to be manufactured on the road, by the storekeeper.

G. G. Yeomans said that it is generally very difficult to arrive at a fair basis of comparison on which the value of a stores department could be determined. He, however, reported a case that he had investigated of a fair-sized road which had had no such department and each of the general departments was handling its own supplies and material. A stores department was organized and a comparison of five-year periods, before and after, gave a very good idea of its value. The average annual operating cost was reduced $1,359,000. Meanwhile the number of locomotives was increased 9.3 per cent a year and the tractive effort 24.9 per cent. a year. The ton-miles increased 30.6 per cent. a year. The car mileage density increased 16.4 per cent. On the basis of purchases, the saving in operating cost directly due to the stores department was $774,000. The cost of handling the material previous to the organization of the stores department was $11,416 a month. The average of the same cost for the next five years was $12,100 a month. This indicates that with an increased cost of $700 a month a saving of over $700,000 a year was made possible.

STANDARD SUPPLY CAR

BY D. D. CAIN, SOUTHERN PACIFIC.

The real purpose of the supply car is to deliver material where it is wanted on a specified time each month, and at the same time pick up all tools and other material not needed and make a monthly clean-up of all scrap on the division. To properly handle material with supply cars, the following will be needed on each division or district: An oil car with the required number of tanks for oil desired on the respective roads. This car should be equipped with hand pumps and with air pressure arrangement. The air is taken from the train pipe line through a reducing valve. A general car equipped with the necessary shelves for small miscellaneous material and supplies for all departments. This car should be arranged with space for sleeping accommodations for the attendants and a desk at which to transact the clerical business necessary. A car with the necessary racks for roadway tools, block signal supplies, large station supplies, and similar material. A car for case oils, gasolene, etc., where used. A car for stationery where delivered by supply cars. A car for spikes, track bolts, and track supplies.

It is economy to use steel under-frame cars for this service. To the above should be added the necessary cars for assembled jobs complete, also for hand cars, velocipedes, frogs, switches, track trimmings, etc., and, where treating plants are operated, lime, soda ash and distillate, and such flat cars as may be needed with side boards for scrap.

The first five cars should be equipped with end doors to enable the attendants to pass from one to another while the train is in motion for the purpose of assembling material for the next stop. These cars should also be equipped with electric lights, which can be installed at a cost of $35 per car. We use a set of the same batteries that operate our block signals.

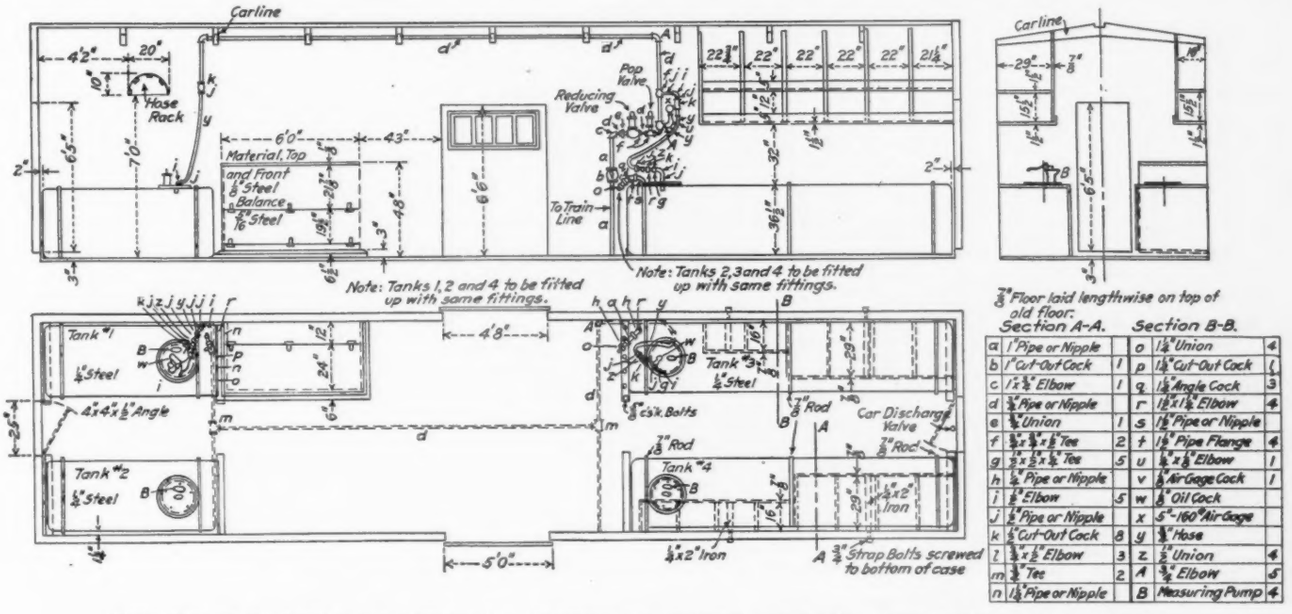
In practically all of our supply trains on eight divisions we use from twelve to as high as thirty cars, depending on the amount of business each month.

With a properly organized division and the supply cars in charge of a thoroughly competent division storekeeper, there is no need for requisitions being delayed by having the approval of every officer on the division. These cars are built for action, and we are going to deliver what is needed and pick up everything that is not needed. Requisitions covering the estimated requirements for the ensuing thirty days are made by all departments and sent direct to the division storekeeper. These requisitions are stamped, "supply car," and turned over to the supply car storekeeper and assistant, who draw off a summary of the material required and check it with the various section storekeepers.

Schedules showing the dates on which these cars move, train numbers, etc., are prepared in advance and placed in the hands of division engineers, roadmasters, section foremen, agents, signal maintainers, pumpers, trainmasters, yardmasters, etc., so that all tools, scrap, etc., may be ready for quick inspection and handling.

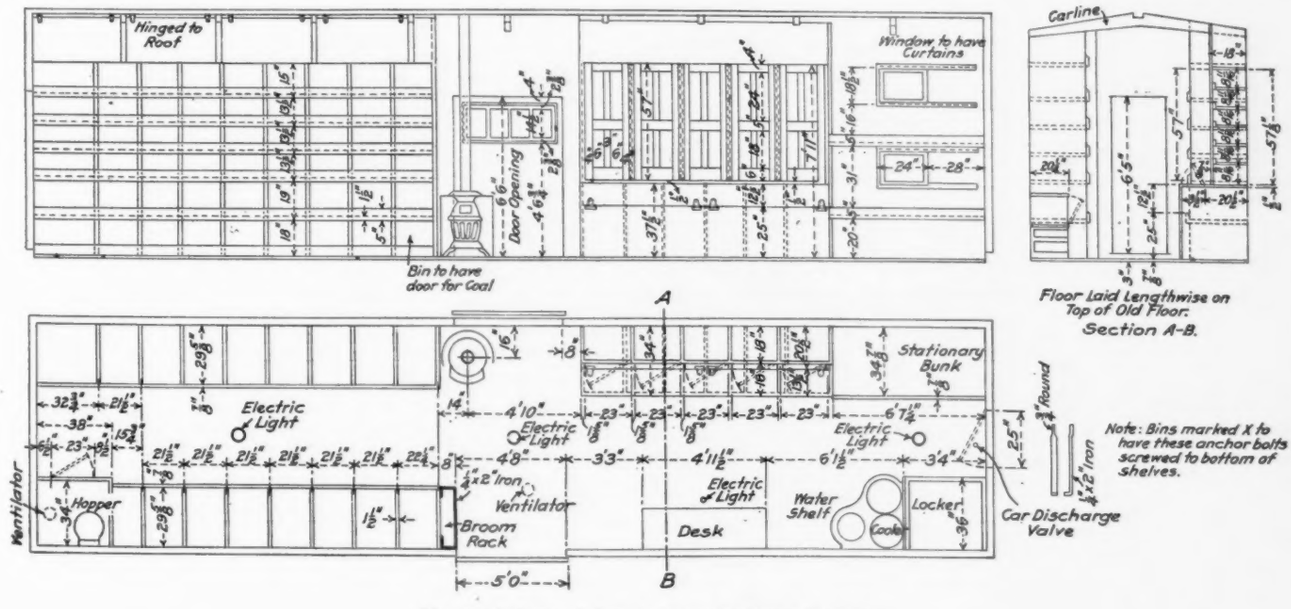
The supply car must always be accompanied by the division storekeeper and by the roadmaster and signal supervisor over their own respective districts in order to be properly handled and to get the best results. Stops must be made at each tool house and station. Tools and supplies required are checked between stations and made ready for quick delivery.

When the supply cars were first instituted on the Southern Pacific we ran them in local trains. We found by handling our cars in locals the proper time could not be given unloading and picking up without seriously delaying the train. The superintendents have combined their own trips with ours. Thus, on practically all divisions we now have our supply trains run on a regular monthly schedule as an inspection train accompanied



a	1" Pipe or Nipple		o	1½" Union	4
b	1" Cut-Out Cock	1	p	1½" Cut-Out Cock	1
c	1"x¾"x¾" Elbow	1	q	1½" Angle Cock	3
d	¾" Pipe or Nipple		r	1½"x1½" Elbow	4
e	¾" Union	1	s	1½" Pipe or Nipple	
f	¾"x¾"x½" Tee	2	t	1½" Pipe Flange	4
g	¾"x¾"x¾" Tee	5	u	¾"x½" Elbow	1
h	½" Pipe or Nipple		v	½" Air Gage Cock	1
i	½" Elbow	5	w	½" Oil Cock	
j	½" Pipe or Nipple		x	5"-160" Air Gage	
k	½" Cut-Out Cock	8	y	¾" Hose	
l	¾"x½"x½" Elbow	3	z	¾" Union	4
m	¾" Tee	2	A	¾" Elbow	5
n	1½" Pipe or Nipple		B	Measuring Pump	4

Floor Plan of Oil Supply Car Showing Air Unloading Arrangement and Racks Above Tanks; Southern Pacific.



Standard General Supply Car—Southern Pacific.

by the superintendent, resident engineer, division storekeeper, roadmaster, etc.

In handling material with supply cars there is the following saving: No delays to trains on account of the train crews stopping at each point during the month to handle thousands of articles needed along the line. No waste labor in packing material. No labor expended in billing thousands of articles that are handled from the supply trains. No cars destroyed for shippers by having oil spilled in them. No billing or shipping back of empty containers to the store. No pilfering of material. No loss from breakage. No claims or correspondence regarding shortages.

One of the greatest advantages of the supply cars is the fact that we are able to carry out the exchange arrangement regarding station supplies, signal supplies, track tools and supplies. This can be accomplished in no other way.

BY L. O. GENEST, CANADIAN PACIFIC.

On the Canadian Pacific western lines eight cars are operated as separate units and patrol 7,500 miles at stated monthly intervals. They are equipped and directed by four divisional storekeepers with a storeman in charge of each car. Deliveries are confined to light supplies and tools such as are required for maintenance purposes for stations, sections, water supply, etc. Requisitions from each of the sixteen sub-divisions are sent to each of the respective divisional storekeepers not later than the twenty-second of the month for the following month's requirements, and are fastened separately in station order for each department and each section or branch, as the case may be, to enable a check to be made in the superintendent's office to insure receipt of all requisitions. The storeman in charge of the car wires the superintendent a day or so in advance stating the subdivision of his district the car will cover so that all concerned may be advised to have their oil cans and old material in readiness for the arrival of the car.

DISCUSSION.

The carrying of handy workmen on the supply train to do small work, such as fitting window glass, repairing locks and hinges, etc., on buildings and other structures along the road, had been found most satisfactory.

THE AUTHORIZED LIST

BY E. J. M'VEIGH, GRAND TRUNK.

The meaning of this is that we have on our railways a list of all the items of material we use; this list to be most carefully compiled, and finally approved by our president and his vice-presidents. This looks like a large order, and it is, but it can be done. This list establishes our standards as they have never before been established. It gives them the stamp of approval, and in getting it up our people will make such a study of the supply question as they have never made before in the history of railroading. With this list in working order each department will know what they can and should ask for. Each storekeeper will know what he can and should have in stock. Any departure from the list will be cause for inquiry. Each inquiry will help to guard our standards and prevent increasing our items. The increasing of our items means the increasing of our stocks on hand.

The association should appoint a committee to look into this question and report, and further, each member of the association should take the matter into careful consideration, and assist the committee by giving them the benefit of his views.

OTHER PAPERS, ETC.

Abstracts of several other papers which were read at the convention will be found in the Shop Practice section of this issue, including Rolling Mills at Scrap Docks, Standard Dry Lumber Shed, Standard Oil House, and Standard Casting Platforms. A paper was also presented on "The Importance of Conforming to the Custom Regulations When Shipping Repair Parts for Cars Disabled on Canadian Lines."

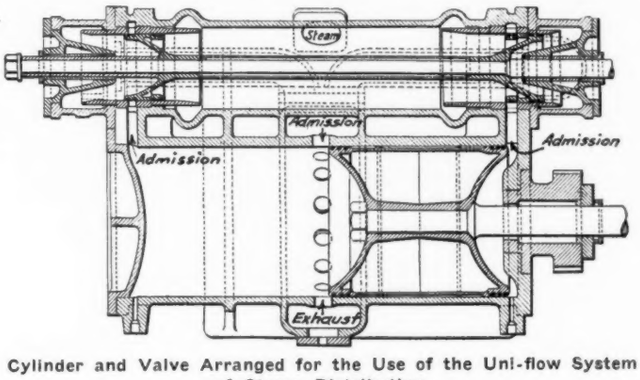
The committee on the book of standard rules made a progress report and evidently have a most complete and valuable report in prospect.

Election of Officers—The following officers were elected: President, J. W. Gerber, general storekeeper, Southern; first vice-president, George C. Allen, general storekeeper, Chicago, Milwaukee & St. Paul; second vice-president, H. C. Pearce, general storekeeper, Southern Pacific; secretary-treasurer, J. P. Murphy, general storekeeper, Lake Shore & Michigan Southern.

STUMPF LOCOMOTIVE CYLINDER

A locomotive on the North Eastern Railway of England has been fitted with an arrangement of cylinders designed for using the uni-flow system of steam distribution. This was briefly explained in the discussion of the paper on "Factors in the Selection of Locomotives," presented at the Railway Session of the American Society of Mechanical Engineers last December. It consists chiefly of an arrangement of special valves, pistons and passages so as to avoid any return or backward motion of the steam after entering the cylinder. Its use requires cylinders of a length nearly equal to twice the stroke and with steam admission ports at either end in the ordinary manner and special exhaust ports at the center. The piston is a large hollow casting of a length practically equal to the stroke of the locomotive. The valve controls only the admission and point of cut-off of the steam and the exhaust is controlled by the piston which opens the exhaust passages at the center of the cylinder as it reaches the end of its stroke.

The construction of the cylinder as applied to the locomotive



Cylinder and Valve Arranged for the Use of the Uni-flow System of Steam Distribution.

on the North Eastern Railway is shown in the illustration which is taken from the *Railway Gazette* of London.

Experiments on the continent with this type of locomotive have indicated that it possesses considerable economical advantage as regards steam consumption. In fact, it is claimed that it is superior to the usual superheater locomotive. This increase of economy is apparently due to the fact that the cylinder walls and the piston head are not cooled as much by the outgoing steam as when the steam is exhausted through the same passages through which it enters. Furthermore the exhaust passage can be made larger and the steam is released much more promptly.

When working at full stroke, as is the case in starting, the valves are so arranged that they add to the exhaust passage and allow a small portion of the steam to escape through the admission passages. This action, however, only takes place when working at practically full stroke.

STATION PLATFORM CHARGES IN ENGLAND.—The London & Northwestern now makes a charge of one penny for admission to train platforms at Waterloo Station, London.

SHOP PRACTICE

ROLLING MILLS AT SCRAP DOCKS

At the annual meeting of the Railway Storekeepers' Association, G. G. Allen of the Chicago, Milwaukee & St. Paul read a paper on "Rolling Mills at Railway Scrap Docks—Economy Effected," an abstract of which follows:

The C. M. & St. P. has, for many years, manufactured practically all of its freight cars and a large proportion of its locomotives, and one of the best methods we have found for employing the rolling mill is to select the scrap, old arch bars, rods, etc., shear them to the proper size, and roll them for special parts that enter into the construction of this new equipment, such as brake hangers, carry irons, brake jaws, bolts, etc., that are required in very large quantities.

Thousands of drift bolts for the bridge and building department are made from re-rolled iron, in fact comparatively little new iron is used for common bolts for any class of work.

The mill was located in the blacksmith shop chiefly for the reason that there was no room, nor were there facilities for doing this work on the scrap dock, and owing to the practice of utilizing the product of the mill for special purposes, a great deal of the iron is worked up in the same shop just as it comes from the mill, and the scrap from the shears, both from the original bar, as well as the cuttings from the finished bar, is used also, in the same shop, in the hammer furnaces. The blacksmith shop location under these conditions is a convenient one, but as a general proposition for roads that have modern scrap docks, equipped with power, hammers, shears, etc., and where the making of special parts is not the rule the scrap dock is unquestionably the proper location.

The billets used are from 12 to 24 in. long and the output of the machine varies from three to six tons per day, depending on the size of the material rolled. The total cost of operation is $18.35 a day.

Various tests made from time to time have demonstrated the fact that the re-rolled iron is of good quality and usually superior to the ordinary grades of new iron, the improvement being due to the additional rolling.

In computing costs and figuring profits, we have endeavored to be conservative. Scrap has always been charged at higher than market prices and all legitimate items of expense added. The cost of re-rolling, not including value of scrap, is from $3 to $6 per ton according to size of iron rolled, and the profits will average $10 per ton.

The net saving of a similar mill at the Burnside shop of the Illinois Central is reported to amount to well over $12 per ton, everything considered except interest on the money invested and the steam consumption. There are no depreciation charges. The present average daily output is three and one-half tons. Cost for labor and fuel $4 to $4.75 per ton, and profits $700 to $900 per month.

The Chicago & North Western is also operating a mill of the C. M. & St. P. type at the Chicago shops, reducing 1¼ in. and 1⅛ in. round bars to ⅞ in. and ¾ in. The daily output is one and one-half tons at a cost of about $8 per ton. In adidtion they have ordered an Ajax three-roll mill, which will have a capacity of from 2 in. to ⅝ in. It is the intention to operate both mills.

The Chesapeake & Ohio has an Ajax reclaiming roll on its scrap dock at Huntington, W. Va. The total cost of rolls, furnaces, oil tanks, shed, motor, etc., was in the neighborhood of $12,000. The average daily output is three and one-half tons on which it is stated they are making a profit of $1,100 per month.

The Southern Pacific Company is operating a rolling mill on the scrap dock at the Sacramento shops, with a maximum output of 190 tons and average output of 90 tons per day. The total cost per ton including scrap is $28.60, and the total profits are $56,000 a year. This, however, would hardly be considered a re-rolling mill proposition, but a general rolling mill.

As the difference between the market price of new iron and the market price of scrap is not always maintained at the same level, the profits from the operation of re-rolling mills must necessarily vary. The greater this difference, the greater the profit, but with sufficient tonnage to keep a mill steadily employed and manned by a regular crew, the profits from such a mill as I have described, having a capacity of from three to six tons per day, should not, at any time, be less than $10 per ton.

The question, therefore, of the economy to be effected by the installation of re-rolling mills at railroad scrap docks is one that each road can readily decide for itself, depending on whether or not it has sufficient accumulation of old material suitable for re-rolling, the present disposition of which is not bringing a return that will compare favorably with the above figures.

DISCUSSION.

W. O. Thompson described the arrangement and proposed operation of a large reclaiming shop that is soon to be built by one of the largest railways. The facilities to be provided are elaborate and well arranged.

A point was raised as to the advisability of using the rolling mills at scrap docks with billets and making new material direct. The consensus of opinion seemed to be that this would not be an economical practice. One member reported that $960,000 worth of material had been reclaimed with a re-rolling mill at a total cost of about half the value of new material.

EXHAUST SYSTEMS FOR GRINDING WHEELS

The New York State Department of Labor has issued specifications for the design, construction and operation of exhaust systems for grinding, polishing and buffing wheels. These specifications were prepared by William Newell, mechanical engineer of the department of labor, and the more important items are as follows:

Minimum sizes of branch pipes allowed for different size emery or other grinding wheels are given in the accompanying table:

Diameter of wheels.	Maximum grinding surface, sq. in.	Minimum diameter of branch pipe in in.
6 in. or less, not over 1 in. thick	19	3
7 in. to 9 in. inclusive, not over 1½ in. thick	43	3½
10 in. to 16 in. inclusive, not over 2 in. thick	101	4
17 in. to 19 in. inclusive, not over 3 in. thick	180	4½
20 in. to 24 in. inclusive, not over 4 in. thick	302	5
25 in. to 30 in. inclusive, not over 5 in. thick	472	6

In case a wheel is thicker than given in this tabulation, or if a disc instead of a regular wheel is used, it must have a branch pipe no smaller than is called for by its grinding surface, as given.

Minimum sizes of branch pipes allowed for different size buffing, polishing, or rag wheels, as they are variously called, are given in the table.

Diameter of wheels.	Maximum grinding surface, sq. in.	Minimum diameter of branch pipes in in.
6 in. or less, not over 1 in. thick	19	3½
7 in. to 12 in. inclusive, not over 1½ in. thick	57	4
13 in. to 16 in. inclusive, not over 2 in. thick	101	4½
17 in. to 20 in. inclusive, not over 3 in. thick	189	5
21 in. to 24 in. inclusive, not over 4 in. thick	302	5½
25 in. to 40 in. inclusive, not over 5 in. thick	472	6½

The thickness given in this table for buffing wheels applies to the thickness of the wheel at the center. In case the wheel

is thicker than given in the table, it must have a branch pipe no smaller than is called for by its grinding surface.

Branch pipes must be not less than the sizes specified, throughout their entire length.

All branch pipes must enter the main suction duct at an angle not exceeding 45 deg., and must incline in the direction of the air flow at the junction with the main.

Branch pipes must not project into the main duct.

All laps in the piping must be made in the direction of the air flow.

All bends, turns, or elbows, whether in main or branch pipes, must be made with a radius in the throat at least equal to one and one-half times the diameter of the pipe on which they are connected.

The inlet of the fan or exhauster shall be at least 20 per cent. greater in area than the sum of the areas of all the branch pipes and such increase shall be carried proportionately throughout the entire length of the main suction duct, i. e., the area of the main at any point shall be at least 20 per cent. greater than the combined areas of the branch pipes entering it between such point and the tail end or dead end of the system. If such increase is made greater than 20 per cent. the area of the main at any point, except that portion of it between the branch entering it nearest the fan and the fan, shall bear approximately the same ratio to the combined areas of the branches preceding that point (i. e., between it and the tail end of the system) as the area of the main at the branch nearest the fan bears to the combined areas of all the branches. (This provision is made to permit the use of a fan having a larger inlet area than the area of the main at the branch pipe nearest to the fan, if desired.)

The area of the discharge pipe from the fan shall be as large or larger than the area of the fan inlet throughout its entire length.

The main trunk lines, both suction and discharge, shall be provided with suitable clean-out doors not over 10 ft. apart, and the end of the main suction duct shall be blanked off with a removable cap placed on the end.

Sufficient static suction head shall be maintained in each branch pipe within one foot of the hood to produce a difference of level of 2 in. of water between the two sides of a U-shaped tube. Test is to be made by placing one end of a rubber tube over a small hole made in the pipe, the other end of the tube being connected to one side of a U-shaped water gage. Test is to be made with all branch pipes open and unobstructed.

Plans for all exhaust system installations, showing location and sizes of all wheels, hoods, main and branch pipes, fan, and dust separator should be submitted to this department in duplicate for approval before work is begun, and it must be clearly specified that the system is to be installed in strict accordance with these specifications. The test specified positively must be obtained before the system will be acceptable to the Department of Labor.

The contract for the installation of an exhaust system should contain a provision to the effect that payment will be withheld until the above test shall have been made and the system accepted by this department.

In addition to the specifications, a number of recommendations are given from which the following quotations are taken:

Emery wheel and buffing wheel exhaust systems should be kept separate, owing to danger of sparks from the former setting fire to the lint dust from the latter, if both are drawn into the same suction main.

In the case of undershot wheels (i. e., the top of the wheel runs toward the operator) which is almost always the direction of rotation of both emery and buffing wheels, the main suction duct should be back of and below the wheels and as close to them as is practicable; or it should be fastened to the ceiling of the floor below, preferably the former. If behind the wheels, it should be not less than 6 in. above the floor at every point to avoid possible charring of the floor in case of fire in the main duct and also to permit sweeping under it. For similar reasons it should be at least 6 in. below any ceiling it may run under.

Both the main suction and discharge pipes should be made as short and with as few bends as possible, to avoid loss by friction. If one or the other must be of considerable length, it is best to place the fan not far beyond where the nearest branch enters the large end of the main, as a long discharge main is a lesser evil than a long suction main.

Avoid any pockets or low places in ducts where dust might accumulate.

If there is a likelihood of a few additional wheels being installed in the future, it is advisable to leave a space for them between the fan and the first branch and to put in an extra size fan.

Branch pipes should enter the main on the top or sides; never at the bottom. Two branches should never enter a main directly opposite one another.

Each branch pipe should be equipped with a shut-off damper or blast-gate as it is also called, which may be closed, if desirable, when the wheel is not in use. Not more than 25 per cent. of such blast gates should be closed at one time; otherwise, the air velocity in the main duct may drop too low and let the dust accumulate on the bottom.

The use of a trap at the junction of the hood and branch pipe is good practice, provided it is cleaned out regularly and not allowed to fill up with dust. This will catch the heavier particles and so take some wear off the fan.

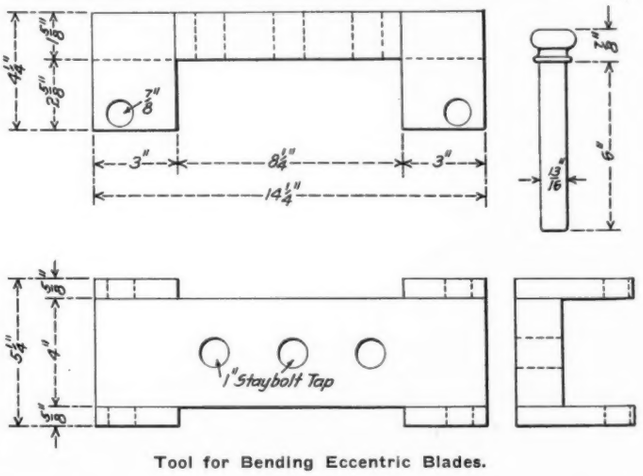
All bends, turns, or elbows, whether in main or branch pipes, should be made with a radius in the throat of twice the diameter of the pipe on which they are connected, wherever space permits.

Elbows should be made of metal one or two gages heavier than the pipe on which they are connected, as the wear on them is much greater.

ECCENTRIC BLADE BENDER

BY H. T. NOWELL,
General Foreman, Boston & Maine, Concord, N. H.

An eccentric blade bender made in one piece, and one that is easy to handle, is shown in the illustration. This does away with the old fashioned two-piece bender with the bar of iron and dog that required the services of two men. It is placed over the blade and two pins are placed in the ⅞ in. holes in the legs to hold it when the set screws are applied through the 1 in. threaded



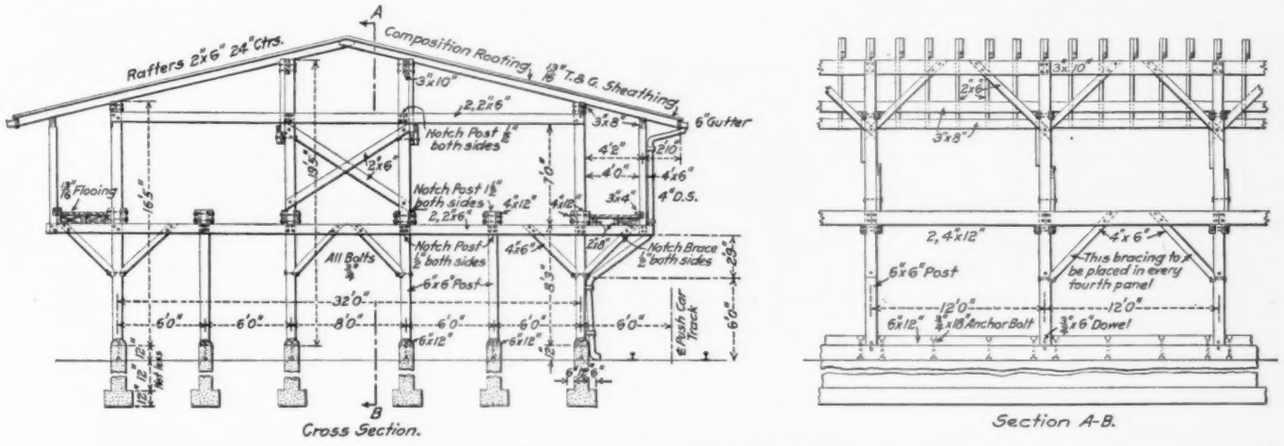
Tool for Bending Eccentric Blades.

holes in the top of the bar. There are three of these holes to allow for the proper application of the pressure. The set screws are made with a fine thread to prevent stripping. This bender has practically no spring or "come-back," and may be readily used in very restricted places.

DRY LUMBER SHED

Two papers on this subject were read at the annual meeting of the Railway Storekeepers' Association in May. J. W. Gerber of the Southern Railway said in part: The proposed shed is 32 ft. in width and of any desired length, in panels of 12 ft. each. Height from the ground line to plate is 16 ft. 5 in. The posts supporting the building are set on continuous concrete foundations which also serve to carry the stringers on which the lumber is piled. The building is divided into two stories, the lower floor having a clearance of 7 ft. 3 in., the upper floor, a clearance of 7 ft. The galleries on the second floor level are 4 ft. in width and run the entire length on either side of the building and are reached by stairways at both ends.

Both ends of the shed are enclosed, and the overhang is 7 ft., which, together with the galleries, which project 4 ft., gives ample protection from the weather.



Proposed Arrangement of Dry Lumber Shed.

Push car tracks are provided on either side of the shed, and outside of the push car tracks standard gage tracks are placed for the unloading of car lots of lumber.

W. E. Hatter, in his paper, said in part: In the erection of a dry lumber shed the most essential and primary feature to be considered is a scientific system of ventilation, which will permit of the drying and seasoning being thoroughly accomplished, without in any way endangering the quality of the material contained within the building.

This result can be brought about by using a mean between the solid sided building, and an open shed. A building of this type would be so constructed that a space of 2½ in. would be left between the siding boards. They should be set at such an angle, however, that it would be impossible for either rain or snow to beat through, although it would always permit of a continuous circulation of air throughout the entire building.

The feature of next importance is that of an adequate lighting system. It is a fact generally understood, that without proper lighting, material is slow to season, and in a great many instances it becomes susceptible to such destructive elements as dry rot, mildew, etc. By the erection of a cupola or secondary roof, throughout the entire length of the building, the light would be permitted to permeate extensively through the building, which would aid materially the working facilities, and assist, as well, in the preservation of the material.

Particular stress must be placed upon the proper building of a special room, or series of rooms, in which kiln dried material may be stored, and where the conditions produced by the kiln will be retained. To properly procure this result, the room or rooms must be so constructed as to be entirely tight, permitting of a series of ventilating pipes on each side of the room, or rooms, by means of which an average temperature would be obtained, and the installation of two 2 in. steam pipes around the entire room. The lumber could, under such conditions, be held ready for use, and need not be again taken to the kiln for drying.

The adoption of slate for a roofing material is to be highly recommended, not only because of the greater safety, but because of its economy.

LAYING OFF SHOES AND WEDGES

BY E. T. SPIDY,
Assistant General Locomotive Foreman, Canadian Pacific, Winnipeg, Man.

At the Winnipeg shops of the Canadian Pacific, the standard practice for lining up and laying off shoes and wedges requires the use of several special instruments. After the frame jaws are squared up, the shoes and wedges, which are finished except for planing the faces, are put in place and supported by the pedestal binders. The spindle holder, shown in detail in Fig. 1, is inserted in the main pedestal, being located as near the center of the jaws as possible. This rests on the pedestal binder and has set screws at the top and bottom by which it can be securely held in place. Two 1¼ in. diameter finished steel bars of the proper length to reach across the frames and extend a short distance be-

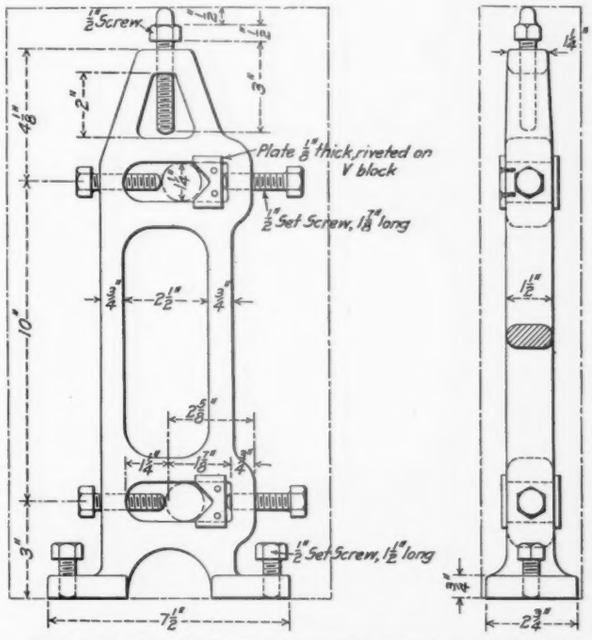


Fig. 1—Spindle Holder to be Clamped in Each Pedestal.

yond the spindle holders, are then inserted in the V-blocks in the holders, and the set screws on each side are adjusted to hold them. On the outside of the frame rail, directly over the center of the pedestal, a circle 1¼ in. in diameter is scribed. Two parallel blocks are then placed on top of the frame, about 12 in. apart, and a steel square, resting on the parallel blocks, is lined to the scribed circle. The position of the two steel spindles is then adjusted by means of the set screws until they touch the edge of the square, which places them in the exact center of the pedestal jaws and in a line perpendicular to the top of the frame. The other ends of the spindles are then set in the same manner.

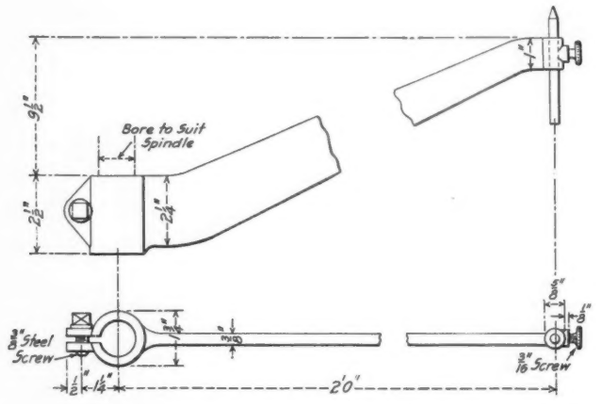


Fig. 2—Lining Up Arm Fitted on the Ends of the Spindles.

The line passing through the center of the cylinders and parallel with the frames is then put up on both sides of the locomotive. The lining up arm, Fig. 2, is placed on the projecting end of one of the spindles and is tried forward and backward for adjustment with the cylinder center line. If it is found that there is a variation, the spindles are adjusted to a position exactly perpendicular to the cylinder center line. This operation is performed for both the upper and lower spindles, and when completed for both sides insures the accuracy of their position or reference to the main driver. The accuracy of this work is checked by means of the lining up arm on each of the other spindles.

The next operation requires the use of the instrument shown

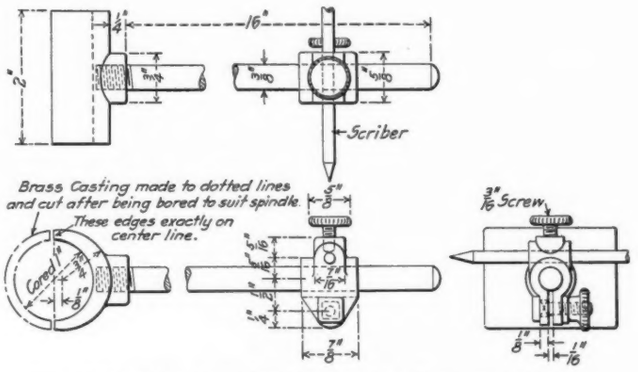

Scriber
Brass Casting made to dotted lines and cut after being bored to suit spindle.
These edges exactly on center line.
3/16" Screw

Fig. 3—Scribing Arm for Marking the Shoes and Wedges.

in Fig. 3, which is called a scribing arm. This is previously set so the distance from the center of the spindle to the marker will be 1 in. greater than the distance from the center of the driving

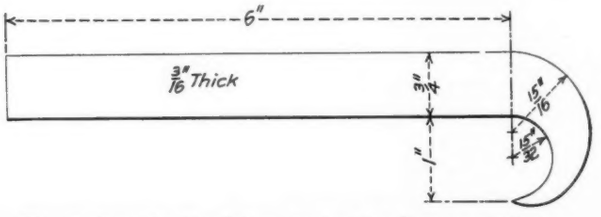


Fig. 4—Gage for Use When Facing the Shoes and Wedges.

box to the shoe or wedge face. It is then placed against each spindle in turn and the shoes and wedges are scribed on each side. The apparatus is then removed and the planer hand, in

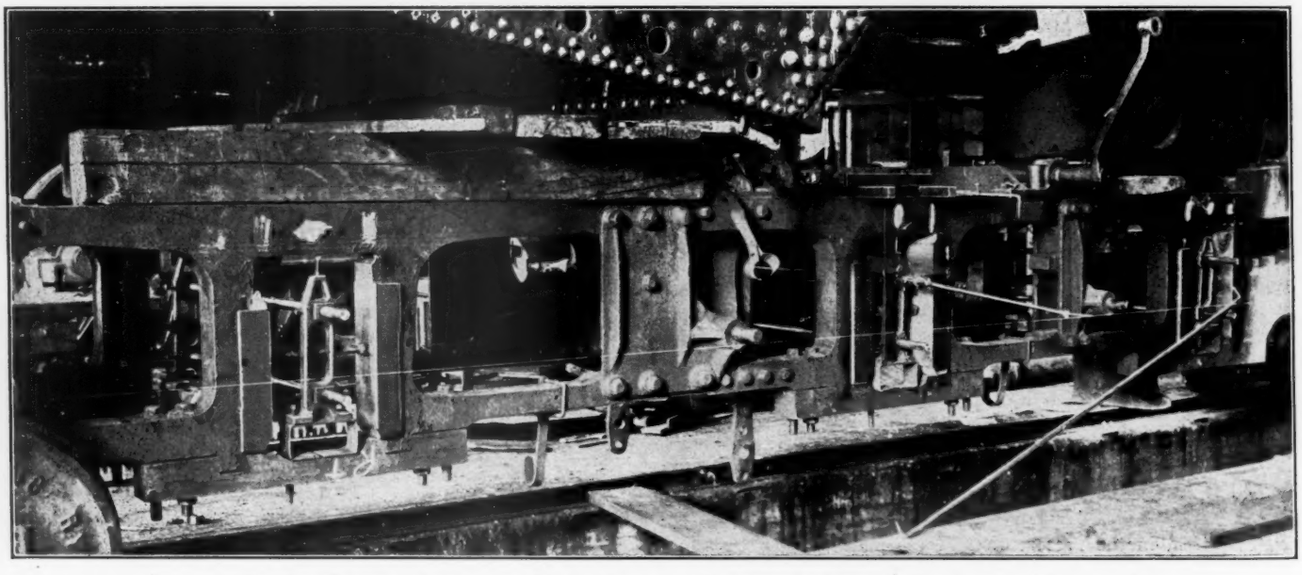


Fig. 5—Apparatus for Laying Off the Shoes and Wedges in Place on the Locomotive.

develops any inaccuracy in the setting of the cylinder center lines.

After the spindles are properly set for the main driver, other holders and spindles are inserted in the pedestals of the other drivers and standard trams are used to locate their position in finishing the shoes and wedges, uses the gage shown in Fig. 4 for setting the machine to remove the proper amount of metal and to insure the squareness of the faces.

The whole apparatus is shown in place on the locomotive in Fig. 5.

MISCELLANEOUS SHOP KINKS

BY W. A. McGEE

LOCOMOTIVE TIRE HEATER.

A portable tire heater that is simple to operate and easily made is shown in Fig. 1. Gasolene is used for fuel, and it is driven from the tank under a pressure of 10 lbs. per sq. in. through a ¼ in. pipe. The gasolene is mixed with air in a pipe that connects with the top of the tank, the air for the mixture being regulated by the valve *A*. The mixture passes through a check valve which prevents the possibility of a back

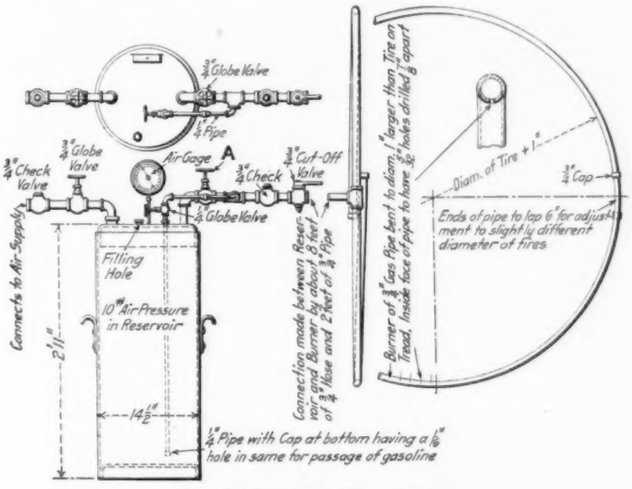

¾" Globe Valve
¼" Pipe
¾" Globe Valve
Air Gage
A
¾" Check Valve
¾" Check Valve
¾" Cut-Off Valve
¼" Globe Valve
Connects to Air Supply
Filling Hole
10" Air-Pressure in Reservoir
2'11"
14½"
¼" Pipe with Cap at bottom having a 1/16" hole in same for passage of gasoline
Connection made between Reservoir and Burner by about 8 feet of ¾" Hose and 2 feet of ¾" Pipe
Burner of ¾" Gas Pipe bent to diam. 1" larger than Tire on tread, Inside face of pipe to have 5/32" holes drilled ⅞" apart
Diam. of Tire + 1"
¾" Cap
Ends of pipe to lap 6" for adjustment to slightly different diameter of tires

Fig. 1—Gasolene Tire Heater.

fire from the burner. The burner is made of a ¾ in. gas pipe, which is bent to a diameter 1 in. larger than the diameter of the tire. An overlap of 6 in. is provided to allow for tires of slightly different diameters. The holes for the gas are 5/32 in. in diameter and are spaced ⅞ in. apart. Handles are provided on each side of the tank, so that it may be easily carried by two men. The flexible connection between the tank and the burner is made with about 8 ft. of ¾ in. hose.

PNEUMATIC BULLDOZER.

A small bulldozer, such as is shown in Fig. 2, will be found valuable in the smith shop. It is operated from the shop air system at a pressure of about 90 lbs., a 16 in. brake cylinder being used on a lever of 30 to 7, which will give a thrust on the plunger of approximately 98,000 lbs. The machine is simply constructed and may be easily made where there are accommodations for making the body, which is a casting. In this particular instance the machine has found a variety of uses, such as for punching key slots in bolts, bending arch bars, body bolsters, step irons, etc., cutting iron and spring steel, and compressing engine and tender springs while the bands are being put on or removed; a spring maker with a helper can put the bands on 10 large locomotive springs per hour with this machine. The dies for punching key slots are made in two parts, being held together by dowel pins. This machine will punch bolts up to 1½ in. in diameter; they are of course heated, before punching. Fig. 3 clearly shows the

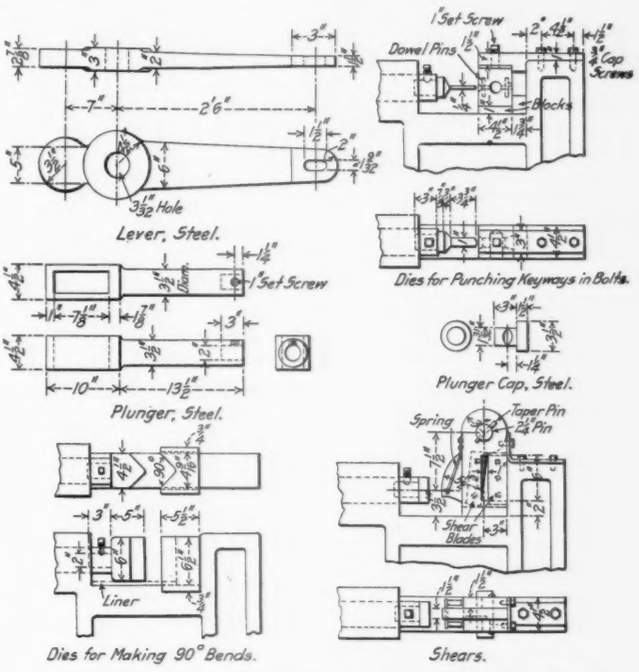
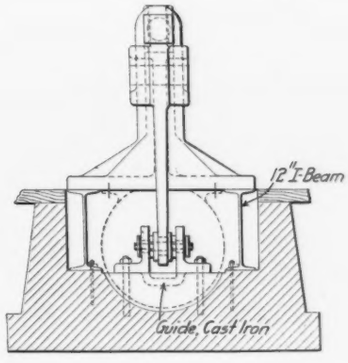


Fig. 3—Details of Pneumatic Bulldozer, with Some of the Dies Used.



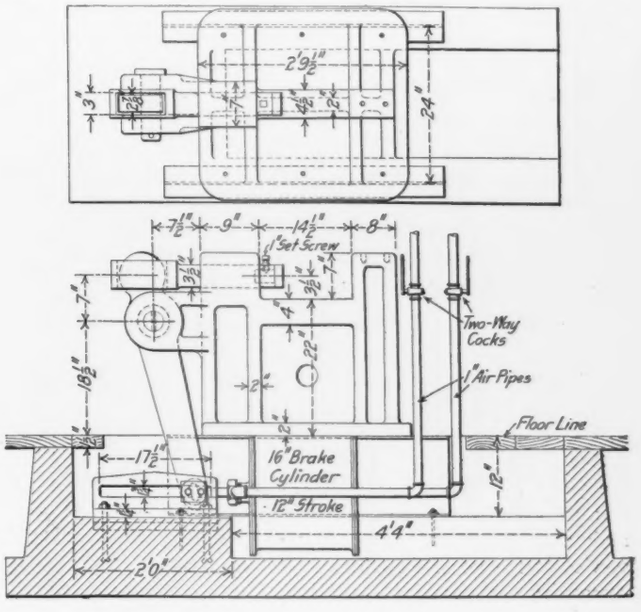


Fig. 2—Pneumatic Bulldozer for the Smith Shop.

construction of a few of the dies used and the way in which they are applied to the machine.

OIL BURNER.

A crude oil burner made up almost entirely of standard gas pipe and fittings is shown in Fig 4. It was designed for heating locomotive frames for welding, and has been found useful in other work. The oil is fed to the burner through a 3/8 in. pipe, which is reduced to a 1/8 in. pipe just before entering the mixer. The air is supplied through a 1/2 in. pipe, which unites

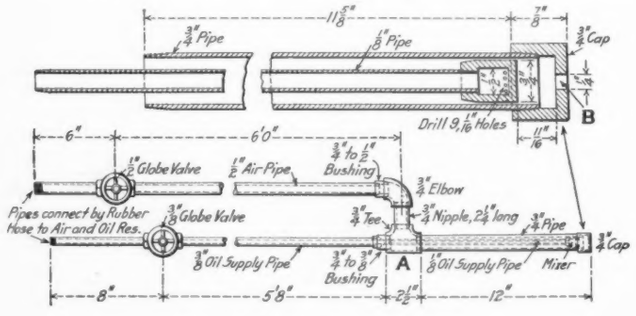


Fig. 4—Burner for Crude Oil.

with the 3/4 in. mixing pipe at the tee *A*. The 1/8 in. oil pipe terminates in a blind nipple with nine 1/16 in. holes drilled around its circumference. As the oil spurts from these holes it becomes mixed with the air and passes out through the hole *B*. By regulating the supply of both the oil and air a proper mixture may be obtained.

STANDARD OIL HOUSE

C. S. Doe, of the Santa Fe, presented a report on this subject before the recent meeting of the Railway Storekeepers' Association, from which the following is taken:

The Santa Fe has discarded the old time oil house maintained separate from the storehouse, which necessitated two extra employees, one each for the day and night, and instead a reinforced concrete basement has been adopted of sufficient size, according to the importance of the division point, to handle the illuminating and lubricating oils, varnishes, japans, greases, compounds, etc.

This oil basement is situated as far from the storehouse as is desired, the roof being a continuation of the storehouse concrete platform used for storage of castings and other material, the oil being drawn by the Bowser system of long distance pumps situated in one end of the storehouse. This places the issuing of oils with the store department employees the same as other materials and eliminates the employing of special oil house men.

The gasolene storage tank is placed in a pit separate from the oil basement, some distance from both the storehouse and the oil basement, and is also drawn at the storehouse with a Bowser long distance pump equipped with a series of safety check valves.

One of the most important features is the handling of oil from the general oil house to the division oil houses. To accomplish this successfully, about forty-five 10,500 gals. capacity system tank cars are especially assigned to the store department for service at the general oil house. All oils ordered from the oil companies are consigned to the general oil house and transferred to these assigned system tank cars, thus saving per diem or demurrage charges.

The state law compels us to have all cans and other receptacles for handling gasolene painted red. This promotes what on railroads is known as the safety habit, which is considered one of the first essentials of economy. Considering this an advantageous movement we have decided to adopt colors for other kinds of oils so that all employees will know at a glance what kind of oil is in a can, drum or any oil container and will also recognize it as company material and handle it accordingly.

The colors adopted are as follows: Red for gasolene, white for mineral seal, yellow for signal oil, green for headlight oil and blue for lubricating oil. These assigned tank cars are also painted with a 24 in. stripe around each end of the tank in accordance with the above, and are stenciled for the kind of oil they are used for, boarded for store department service, and never used for any other oil unless released by our department.

All hose, pipes, valve connections and other fittings are also painted according to colors, and there is no chance of getting the oils mixed in taking a supply.

All tank cars are fitted with outlet connections exactly alike, as are all hose, pipes, connections and fittings at the division oil houses, so they do not require any special work in taking the supply, and a tank can be connected in a few minutes after being set for unloading.

These tank cars on leaving the general oil house under load are routed over the line making from five to ten points, according to the distance and the amount of oil required; they are then returned to the general oil house, reloaded, and again routed out for another trip, and are routed so each tank makes a trip about every thirty days; we have enough tanks to cover the entire road in this period. A weekly report is required giving the amounts of all oils on hand to the storekeeper in charge of the general oil house, and upon this information tank cars are handled accordingly.

Blue print calibration sheets are on file in the office of all division storehouses giving the number of gallons to every one-half inch, and as a tank car is handled at the division oil house, a report is made of the number of inches before and after taking a supply. This is a complete check and no point can take more oil than is covered by requisition.

The general oil house is of reinforced concrete throughout, including the roof, and no inflammable material is used in its construction. It has one story and a basement, and is 50 ft. wide x 160 ft. in length. The storage capacity for illuminating and lubricating oils is about 125,000 gal., and consists of a series of 10,000 gal. tanks. The storage for turpentine, varnish, japan, paints, linseed oil and similar materials consists of a battery of tanks erected in such a way that by the use of an air hoist and carrier, barrels can be raised to a track and run by gravity to any desired tank and emptied. The material is then drawn for shop use or shipment by the long distance, automatic measuring, pump system.

A sufficient space is partitioned off by a steel door where the heavy paste and compounds are kept in open stock for retail purposes; thus should fire be caused by spontaneous combustion, it will be confined to this steel compartment without danger to any other part of the building.

On the main floor are located thirty-two self measuring pumps, handling all kinds of oils from the storage tanks in the basement, except heavy paste and compound. Steel counters are used for waste and journal packing, while standard steel shelving is used for can paints and similar material. One side of this floor is used for storing of waste in bales and will be partitioned off with a fine screen wire to protect it from pieces of oily waste or anything which might cause fire.

Eleven power pumps are installed for the transferring, unloading and loading of tanks and supply cars, and for filling of drums and barrels for road shipments. These pumps have a capacity of from 8,000 to 10,000 gal. each an hour, and the maximum quantity of oil that can be transferred in a day is almost unlimited.

In connection with the facilities on this floor, attention is called to the indicating gages, in appearance similar to a steam or air gage, that register the amount of oil in the storage tanks in the basement at all times, and can be placed anywhere in the building, on the wall, or in the office, and show at a glance just what oil is on hand, thus saving the necessity of going to the basement to take measurements.

SANTA FE APPRENTICE INSTRUCTION

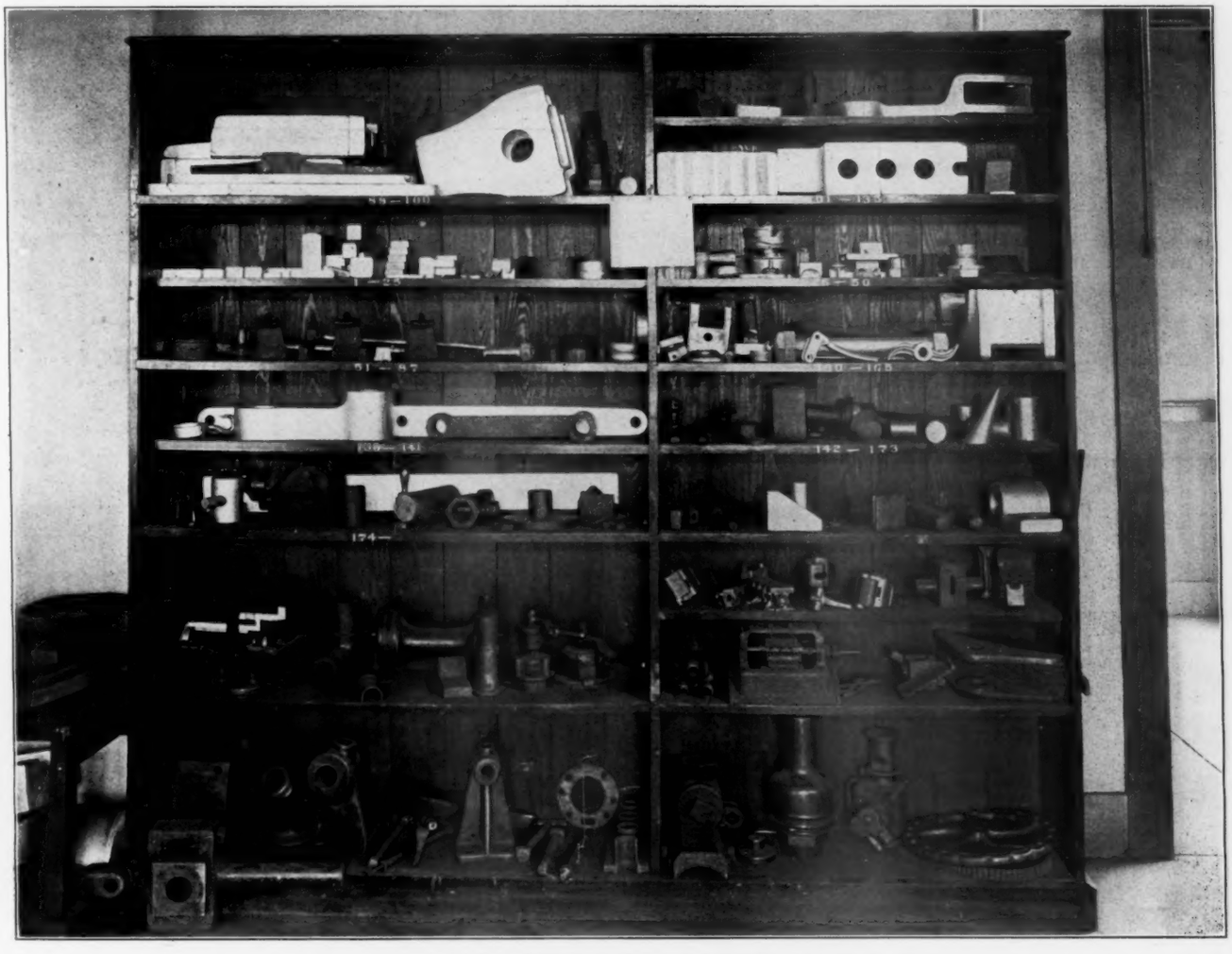
BY REUBEN T. PEABODY.

A few years ago the problem of where to get trained and able men for shops and factories had become a serious matter among mechanical men; every effort was made to obtain them, but few were available. Because of this condition existing on its lines, the Santa Fe established apprentice schools, first at the larger shops and then at the division points. In the beginning, these schools were experimental and in some respects crude, but the difficulties were overcome rapidly and the officers became convinced that they were solving the problem.

Under the old apprentice system a boy was taken into the shop, given a few tools and put to work by a busy foreman, who had no time to instruct him or to pay attention to his welfare. The boy was left largely to his own resources. Frequently some of the men in the shop ridiculed him and took pains to make his work hard and to enjoy his mistakes. If he did not become discouraged and quit, when he had finished his four years' course he had learned what he had been able to observe, what the men had shown him, and what little his foreman had told him.

For example: an apprentice boy, turning and facing packing rings for air pump pistons, was turning out a large number each day and thought he was doing good work. One of the mechanical officers incidentally examined the rings and found them defective. He surprised the boy one morning, by asking him to accompany him with the foreman to the shop superintendent's office, and to bring with him a few of the finished packing rings. After examining the rings carefully and finding them slightly defective, the shop superintendent questioned the foreman and also the boy, and found that while both of them thought the rings were good enough, a bench hand who fitted them in the piston head was expected to square them up with a file, which took considerable time and should have been unnecessary. The lathe was equipped with proper chucks, tools and jigs, but the finished packing rings were not always faced square and sometimes were a little rough, because the apprentice boy did not know how to sharpen his tools properly. If he had been shown how to do this, he could have done more work and the rings would have required only a slight touching up with a file, thus saving several hours' time each month and making the boy a better workman.

The Santa Fe has developed a system of apprentice instruction by which every movement of the boy is directed from the first hour he is in the shop, and, under able shop instructors he receives the help he needs from the beginning of his first day's work, continuing each day until he has finished his course.



Models Used in Connection with the Drawing Lessons.

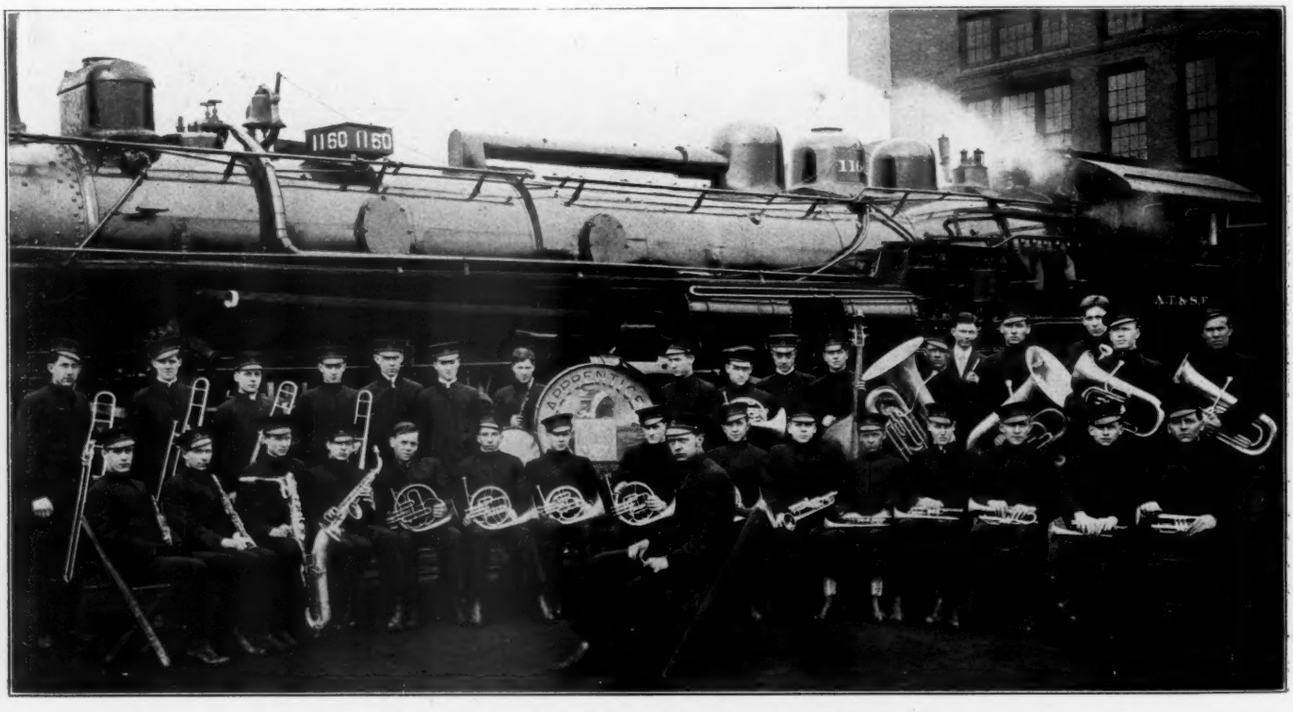
Applicants for apprenticeship must pass a physical examination; be between 16 and 22 years of age, except in cases of special apprenticeship, when there is no maximum age limit; and preference is given to sons of employees. In addition to the physical examination a boy is examined and questioned closely by shop and school instructors as to his mental quali-

fications and talent for the trade he desires to learn. After being admitted as an apprentice he is given six months to "make good," or prove his fitness.

The shop instructors are all practical mechanics, chosen carefully, and able to give instruction and to perform each detail operation in their departments. If it is a machine operation, the apprentice is shown how the work is held in place in the machine, how the cutting tools are sharpened and set in correct position, and how the machine is operated. He is shown how each detail of his work is best performed, and told why it should be performed in that particular way.

Every applicant for apprenticeship is supposed to have a common school education, but to encourage him in a desire for additional knowledge, to broaden his mind and enable him the more easily to master his trade, schools of instruction have been established at all the principal shops and division points, and in addition to their shop training the boys attend school four hours each week. This may seem a very meager length

Apprentice School Room at Topeka, Kan.—Atchison, Topeka & Santa Fe.



Apprentice Band at the Topeka Shops of the Santa Fe.

of time to allow for school room instruction, but as this time is devoted to the acquirement of the technical knowledge applicable to their trades, four hours a week of careful attention to study have been found to be sufficient to obtain the good results. School room instruction is given in railroad mechanical and free hand drawing and shop mathematics. The boys are taught the correct name and function of each part of locomotives, passenger and freight cars, how it is made, its shape or form. In this way they soon learn the uses of metals and the strength of materials. Every day during their apprenticeship they see in the shop practical illustrations of what they are learning in school. This is done to some extent in colleges; but it is not nearly so practical nor thorough, because here the boy realizes that every piece of work on which he is engaged will be put into actual use and must be done right. Before receiving his diploma as a graduate apprentice, he must pass a rigid examination covering practically every branch of his trade.

Both the shop and school room instructors must have unlimited patience; frequently it is necessary that they show and explain the same thing several times. They must also be enthusiastic about the work. It is this enthusiasm which the instructor instills that keeps up the fighting spirit of the boys and makes them determined to master the hard tasks. It is an inspiration to the boy, and, once acquired, he seldom loses it. The apprentice instructors have great opportunities to develop the character of the boy. No boy will be employed or retained who smokes cigarettes or uses intoxicating liquors. The Santa Fe wants men with steady nerves and clear brains, so it begins with the boys. While a thorough knowledge of his trade is necessary, if the boy is morally clean, is honest, truthful and loyal to his employer, if he has confidence in his ability and determination to do right, he will learn to do his work much better, and without question will be of more service to the company. Apprentice instructors have made excellent workmen out of boys that some foremen had discouraged and were ready to dismiss. By patient encouragement, the instructors gained their confidence and interested them in a determination to succeed.

The healthy amusements encouraged by the apprentice schools are of great benefit. Every year the boys have their local football and baseball teams, and play with each other in their own parks, provided by the road. Trips are often made to decide the championship between rival schools. This affords lively competition and real sport. The apprentice bands offer opportunity to the boys to acquire a considerable amount of musical skill under intelligent supervision. The road is taking cognizance of the fact that "all work and no play makes Jack a dull boy." It has come to realize that a boy is not a man, that he cannot be expected to stand all day under a steady grind, without the stimulus of school work and healthy, interesting and elevating recreation.

The Santa Fe officials have given the apprentice schools their endorsement, and have been interested in the development of the work. John Purcell, assistant to the vice-president, was the originator of the idea and has given the present school his help and loyal support. Years ago, while he was master mechanic, he organized a school for the instruction of apprentices in his shop, paying the instructor from his own pocket. It must be a source of gratification to him that seven of the boys who profited through his personal interest and generosity now occupy official positions in the mechanical department of the road.

Necessarily, such an organization as the Santa Fe apprenticeship system requires at its head a man who combines all the qualities enumerated, together with that quality of generalship and intense sympathy with the movement which is indispensable in bringing all its phases into strong co-ordination. Beginning at Topeka in 1907, Frank W. Thomas, supervisor of apprentices, organized and extended the apprentice school system until there are now thirty-four shops and roundhouses where apprentices receive instruction under his supervision, and on February 28, 1913, there were 778 boys working at various shops and roundhouses; 223 of these were at the Topeka shops, the largest on the system. Mr. Thomas is a man who has the welfare of every boy at heart, and is constantly striving to devise new methods to improve his practical and theoretical education. The success of his efforts is proved by the large number of graduate apprentices who have become foremen and who have filled other positions more important than that of regular journeymen.

As a graduate apprentice of the Santa Fe apprentice system, and one who appreciates the benefits derived from it, I believe I am competent to say that the natural outcome of this training is a spirit of loyalty to the school and road that can be engendered in no other way. The value of the side issues is at once apparent when we consider that band and athletic practice and performances take up a large part of the boys' time outside of working hours, furnishing them companions of their own age and kind, with similar ambitions, and giving them less time to develop degrading habits and associations, all tending to supply the road with workmen, competent, highly trained and intelligent—the kind of men necessary to maintain the road on the highest plane.

STANDARD CASTING PLATFORMS

A paper on this subject was presented before the annual convention of the Railway Storekeepers' Association in May, by D. Kavanagh (C. R. I. & P.). An abstract follows:

It is desirable that the casting platform should be car floor height. In case it is not practical to have it at car floor height, there should at least be a small platform for loading and unloading cars that should be reached by a platform hoist. An elevator or hoist of this description is also very desirable when castings are stored on an elevated platform, as it is a good deal more economical than attempting to handle material to and from the shops on an inclined plane or runway.

The size of the casting platform should, of course, be governed by the volume of business that is being handled, and the space allowed for castings should be such that additional castings from new patterns can be accommodated.

The platform should be so arranged that sufficient space is allowed to pile castings of different pattern numbers separately. Each kind of castings should be located together and in numerical order of pattern numbers as far as possible; that is, all grates, piston heads, draw castings, steam pipes, etc., should be grouped separately, as this arrangement makes a neater looking casting platform and also is more economical in putting away castings or getting them out for shipment, and is in my estimation a better plan than attempting to group various castings together for any certain class of locomotives.

Finished castings should be kept under cover or out of the weather. A shed should be provided with the necessary racks to accommodate such material as cylinder packing rings, vibrating cups, etc., and the larger finished castings, such as crossheads, piston heads, cylinder heads, etc., should be kept on the floor suitably arranged for convenient handling. The office of the casting platform foreman, or stockman, could be located in this building. The finished casting house should be heated, as this class of material deteriorates not alone in the open air, but also in the natural moisture of an unheated building. A hoist of some kind should be provided in all cases for handling heavy castings, such as locomotive cylinders, driving wheel centers, etc. The stock book records of castings should indicate the pigeon hole number in the particular rack, or the aisle number in which the castings are located. It is also very desirable that as much information as possible with reference to the particular use of each casting be shown in the stock books, indicating the particular class of locomotives on which it is used, the number of engines in the class, etc.

MASTER BOILER MAKERS' ASSOCIATION

Addresses and Abstracts of the Reports and the Discussions at the Seventh Annual Convention.

The seventh annual convention of the Master Boiler Makers' Association was opened at the Hotel Sherman, Chicago, on May 26, by President M. O'Connor, general foreman boiler maker, Chicago & North Western.

After prayer by John H. Smythe, the president called on W. L. Park, vice-president, Illinois Central, to address the meeting. Mr. Park confined his remarks largely to a discussion of the federal and state laws affecting railways, and particularly to those in connection with locomotives. It was pointed out that associations of the character of this one had a duty to perform in protecting the public from the passage of unfair and unjust legislation. He believed that while there is much to praise in some of the laws, particularly the boiler inspection law, they are not all impersonal, and some are even vicious. He advised the association to watch the proposed laws in its field, and by its activities give publicity to those which are inconsequential, unfair or intended for personal gain. He stated that there is little cause for criticism of the boiler inspection law or its enforcement, but the full crew laws are an outrage and the headlight laws are unnecessary.

John F. Ensign, chief boiler inspector, Interstate Commerce Commission, in an address, advocated that the master boiler makers have charge of all workmen making repairs to the boiler or its attachments. This to include the wash-out men, the machinists who repair or adjust safety valves, injectors, etc., as well as the boiler makers who caulk flues, put on patches or inspect the boiler. In reviewing the record of accidents as shown in the report of the department, it was pointed out that many of the causes could have been removed by a more careful inspection. Greater care in this respect was strongly urged on the members. As an example of the efficiency of the government inspectors in work which could as well have been done by the railroad inspectors, it was stated that during nine months over 4,000 locomotives were ordered out of service and not a single appeal was made to overrule the action of the inspectors.

President O'Connor in his address spoke strongly in favor of more attention to the welfare and education of apprentices.

Secretary and Treasurer's Report.—The total membership just before the convention was reported to be 313, but during the first day, 68 applications for membership were received. A balance of $441.61 was shown by the treasurer's report.

At the opening of the second day's session, C. A. Seley, president of the American Flexible Bolt Company, and formerly chief mechanical engineer, Rock Island Lines, delivered a short address, confining his remarks largely to the subject of regulative legislation. The railways are the only corporations under government regulations that are not permitted to regulate the price of their product. He joined Mr. Park in urging the members to keep track of what their representatives in Congress are doing and to furnish them with information on subjects with which they can have had no experience and which may be under consideration for action at Washington or some of the state capitols. In this connection he disclaimed any intention of criticizing the boiler inspection law which, together with its manner of enforcement, he praised.

Mr. Seley extended a word of warning to the members in connection with the entertainment features of the convention, advising that care be taken that they should not become too elaborate and expensive.

LIMIT OF LENGTH OF TUBES WITHOUT A MIDWAY SUPPORT

The report of the committee was to the effect that 2 in. tubes, 22 ft. in length, had not proved higher in cost to maintain than shorter lengths. Tubes of longer lengths, to the limit of 24 ft., were always 2¼ in. in diameter and were provided with midway supports. The midway supports had proved a detriment in connection with removing the tubes. It is believed that 2 in. tubes up to 22 ft. in length do not require a midway support, but there is no proof available that such a support would not be of benefit. Experiments with a reinforcing sheet 8 in. from the back tube sheet, which held the tubes rigidly did not show any particular improvement in the durability of the joint or bead, but gave some advantages in other directions not mentioned. A 2 in. tube swedged to 1⅞ in. at the back tube sheet gives much better results than the larger tubes from a point of service and maintenance.

The report on this subject is signed by J. A. Doarnberger, chairman; E. E. Stillwell, T. J. Reddy, H. J. Raps and Martin Yale.

Discussion.—There was a general objection to the use of a midway support in the boilers due to the interference with the circulation, the difficulty of removing tubes if scale is present and the liability of the tubes being injured by vibration against the supporting plate. The general opinion was decidedly in favor of long tubes, and most of the speakers did not believe the tubes of present maximum length gave any increased trouble. A few, however, had found a greater tendency to leak with the longer tubes. This they believed to be due to the greater expansion rather than to vibration or sagging. A method of putting in flues where the tube sheets are forcibly drawn out for a distance of ⅛ in. before the tubes are rolled was mentioned. This forces the tubes to arch slightly when the boiler is cold. No improvement was mentioned by following this plan.

WEAK AND UNSAFE CONDITION OF BOILERS

Weakness and defect in the design, construction or workmanship, improper treatment, carelessness, neglect, or ignorance on the part of the boiler attendant; wasting from wear, tear and corrosion; over-pressure, worn out condition and overheating from lack of water; defective condition of safety valves and other mountings; exposure to conditions which cause development of defects, or a general deterioration of the boiler are the chief causes of boiler explosions. Contributary causes are in part due to rigidity of construction. This restrains the necessary movement of the parts under expansion and contraction, and may produce cracks, ripping of plates and leakage. Rigid staying neutralizes expansion and is very detrimental to the boiler. Improper disposition of the stays causes inequality in the distribution of strains, thus producing distortion, leaky seams, ruptured stays, cracks and ripping of the plates. Lack of provision for expansion is a frequent cause of trouble.

A well designed boiler should have every part of the same strength at all temperatures, and so placed that adjacent parts will expand and contract together under all conditions and will not work against each other. All material should be uniform throughout, strong enough to carry its individual load, but not so strong as to fail to give and exert an injurious force on any other member of the boiler.

A poor and careless workman may cause many defects. First, in allowing poor plates containing blisters and laminations to be used. Then by careless handling in the forge fires he may burn the material. Good metal may become burnt in flanging, bending and welding. The sheets may be scored along the seams by sharp calking tools. The rivets may be burnt or imperfectly upset, and other troubles may be brought about by poor work in the boiler shop.

Improperly made repairs with too strong or the wrong grade of material where the expansion and contraction of the patch

plate do not correspond with the old material of the boiler, may work great injury. Patching is a very important job, especially on the firebox and barrel.

Bad management is the chief source of boilers getting in a weak and unsafe condition. All troubles can be discovered before the danger line is reached by careful, painstaking and competent examinations. A well constructed boiler, properly repaired, with proper and frequent cleaning out may become weak and unsafe because it is not properly taken care of.

Committee.—E. W. Young, chairman, and J. H. King.

Discussion.—Careless workmanship in rolling the shell plates for boilers was mentioned as, in some cases, making the boiler weak before it went into service at all. This referred to the forming of the extreme edges where the butt joint is made.

That the proper procedure in case of a hot crown sheet is to put in feed water as rapidly as possible, at the same time deadening the fire by covering it with fresh coal, was explained to some of the members who still held the exploded theory of the rapid flashing into steam of cold water on a hot sheet and a large increase in the pressure.

WELDING SUPERHEATER TUBES

All safe ending should be done at the firebox end. This is brought about by the necessity of always having good and new material at that location. It is the opinion of some of the committee that there should not be more than one weld in these flues at any time.

To apply the safe end at the firebox end, it will be necessary to cut the flue as close to the front flue sheet as possible to avoid waste of the body flue, and reduce the necessity of applying long safe ends. The average life of a body flue of this dimension, in this particular service, would not exceed four safe endings. The average flue welding machines are built so they can weld a safe end 14½ in. long. This can be done by first welding on a 5 in. piece, second an 8 in. piece, third an 11 in. piece and fourth a 14 in. piece. At the expiration of this time the body flue will be about worn out. To do this it will be necessary to cut the flue close to the front flue sheet, as well as close to the old weld in the back end. In repairing in this manner there is always a new safe end at the firebox end, as well as a flue with only one weld.

The best tools for welding these flues is a debatable question. In many localities the dimensions of old welding machines, regardless of type, have been increased, and it is claimed that satisfactory results are being obtained. At some places a welding machine is used that revolves around the flue. This is reported to be successful, but some objections to it have been raised.

The question as to whether the flue should revolve on the roller in the machine, or the machine around the flue, devlops a difference of opinion. To revolve the flue around on the roller requires some time for the flue to travel the distance and, being of very light material, it is likely to become cooled before the entire weld is made. It also requires more power and labor to operate and weld the flues successfully with a machine of this type.

With a machine that revolves around the flue the weld is made much quicker and with less power and labor, but this machine also has its faults. First, it is claimed that it does not make a smooth job on the inside, but leaves an obstruction in the flue that is likely to cause it to clog rapidly. This is a serious objection, as it is necessary to have these flues clean at all times. It is also claimed that it is hard to weld the safe end on these large flues and keep them straight with this type of machine.

Committee.—B. F. Sarver, chairman; J. J. Orr and J. P. Malley.

Discussion.—No especial trouble was reported by any of the members in the successful welding of the large flues. The revolving rollers were generally favored in preference to revolving the flue while welding. The possibility of chilling the metal to be welded by the cold mandrel on the inside was mentioned. Flues are generally being safe ended at the back or small end. At some shops either end is welded as seems desirable.

EFFECT OF SUPERHEATERS ON THE LIFE OF FIREBOXES AND FLUES

The committee is unable to find any well founded claim to show that superheating of steam has a detrimental effect on the fireboxes or flues, but, to the contrary, it is shown that the life of these parts is prolonged considerably, from the fact that where steam is superheated the working pressure is generally reduced. However, there are many large engines carrying 200 lbs. working pressure with superheaters that show no ill effect on the fireboxes or flues.

Committee.—C. L. Hempel, chairman; H. M. Newgirg, E. E. Rapp, P. J. O'Malley and P. E. Cosgrove.

Discussion.—Owing to the usual decrease in pressure on superheater locomotives and the smaller amount of water evaporated, it was generally believed that the use of superheaters increased the life of the firebox and tubes. The dampers have given considerable trouble in connection with proper maintenance, and it was suggested that they be eliminated. It was explained, however, that this was not practical and that the only railway that had taken them off was again using them. Welding the back end of the flues was being successfully accomplished at some shops. A life of three years was indicated for the joint with this method of fastening.

MR. QUAYLE'S ADDRESS.

At the opening of the third session, Robert Quayle, superintendent of motive power and machinery, Chicago & North Western, addressed the meeting. He urged each man to take his share in the activities of the meeting in order that all may get the greatest benefit. A boilermaker should be familiar with chemical and physical properties of the materials he is using. In his opinion, punches would soon be taken out of boiler shops for use on boiler plates. Greater care must be used in laying out and forming the sheets and no material with the slightest defect should be used.

The boiler inspection law has been most helpful and has made for improved conditions. The inspectors generally were believed to be most efficient and, especially, if met in the proper spirit, were anxious to cause as little inconvenience as possible. Fair dealing with the federal inspectors was strongly urged by the speaker.

MR. MC NAMANY'S ADDRESS.

Frank McNamany, assistant chief inspector, Interstate Commerce Commission, was invited to address the members and spoke breifly on the subject of federal laws as applied to rolling stock. It was pointed out that, in each case, the law did not go beyond accepted good practice, but selected the best practice in use and forced its general use.

OXY-ACETYLENE AND ELECTRIC WELDING

The committee reported general success with the oxy-acetylene method of welding and cutting with the exception of vertical seams in the firebox. This difficulty is being overcome by the use of round or oval patches. The cutting and welding of superheater pipes at the bends, in place of using castings at these points was reported to be a successful practice at some shops. Electric welding is also successful, but the inability to cut with this system is an objection. Electrically welding flues in the flue sheets was mentioned.

Discussion.—Electric welding has been most successful on the Erie. There are eight machines in operation on the eastern lines and 60 per cent. of the work is on boilers. It was stated that cracks of all kinds can be welded. It is the practice to heat up the plate by means of steam on the inside of the boiler before beginning operations. The opening to be filled with

welding material must be extended clear through the sheet and leave an open space at the bottom. The weld is carried to a thickness ⅛-in. greater than the sheet. It is very important that the welding material be hammered while hot and the more promptly this is done the better the results. There are now over thirty full sets of tubes welded to the tube sheets in service on this road, in addition to many partial sets. The method followed in this operation is to set the copper ferrule 1/32-in. back from the edge of the sheet, roll it, insert the tube, having it project 3/16-in. beyond the sheet (¼-in. in the case of superheater tubes), roll lightly, prosser and then weld around the extension and to the sheet. After the welding is finished the work is smoothed off by a special tool and gone over lightly with a beading tool. Button head crown stays are also being welded when they become loose. Eight tubes or crown stays can be welded in an hour. The necessity of having all parts to be welded thoroughly clean was impressed on those who had not had experience with this process. The voltage and amperage must be varied to suit the condition of the work.

Both the oxy-acetylene and electric welding outfits are necessary for the best results, according to a number of the speakers. Each has its advantages and disadvantages on different classes of work. One speaker had had no success with welding cracks at the edges of the sheets, particularly those in the fire door flange. A complete ring was inserted around the door and gave good results. In welding patches on the side sheets with oxy-acetylene it appears that the longitudinal seams are generally satisfactory but the vertical seams usually fail after two or three months. Round or oval patches are satisfactory however. The advisability of welding cracks, according to this member, depended on the length of time before the engine would go to the shop. Frequently such repairs were made in order to keep the engine in service, although it was not believed they were permanent. Welding of flues is not advisable in bad water districts on account of the increased difficulty in removing them at frequent intervals.

It was stated that the federal inspectors would not permit the welding of staybolts.

It was also stated that there was no danger or inconvenience to the other workmen on a locomotive on which electric welding was being done.

BEST FORM OF GRATES

C. J. Murray, Chicago & North Western, chairman of the committee, reported on grates for burning lignite. These are a rocking table grate which is identical with the former types of wood grates and is similar to grates used on some roads for burning hard coal.

F. D. Timms, a member of the committee, favored finger grates with the fingers 6 in. in length and with dump grates at the back of the firebox, for burning bituminous coal.

Discussion.—The type of grate in use on the Chicago, Burlington & Quincy was described. This consists of a series of table grates, each of which includes a rocking finger grate. There are no dead grates and the fire is dumped by tilting the table grates, together with the finger grates. In this way the fire is emptied without opening the fire-door or turning on the blower, thus preventing a heavy draft of cold air through the tubes.

BENEFIT DERIVED FROM TREATING FEED WATER

The practice of treating feed water is not general; it is used by a number of railroads, particularly where water conditions are bad. The usual treatment consists of mixing a solution of soda ash and lime, the relative proportions having been determined by chemists.

Water is treated to prevent the formation of scale and foaming. Reports indicate good results from use of soda ash and caustic soda. There is some difference of opinion as to benefits derived from treated water as a preventive of corrosion. One member reports the use of a polarized metallic preparation, applied direct to the boilers in bars distributed over the crown sheet and tubes before closing the boiler and after each washout. This produces an effect more mechanical than chemical; it has an affinity for the material the boiler is made of and forms an amalgam over the boiler plates and tubes which prevents scale forming, also in the case of dirty or scaly boiler the fissures in the scale render it susceptible to removal because the material gets access to the plates and tubes through them, resulting in the scale becoming rapidly loosened and removed, falling to the mud ring or to the bottom of the boiler under the tubes where it is blown or washed out.

Complete or accurate data are not available, but the reports indicate that life of the flues and fireboxes has been lengthened from 150 to 500 per cent. by using treated water. Also it shows a substantial decrease in the cost of maintenance and running repairs.

The Santa Fe reports a cost of 4 cents per thousand gallons for treating feed water; the Canadian Pacific advises that the cost ranges from 2 cents to 5 cents, according to conditions. The polarized treatment costs about 3 cents per thousand gallons.

Committee.—A. E. Shaule, chairman; Geo. Austin, T. W. Lowe and G. C. Wehling.

J. F. DE VOY'S ADDRESS.

J. F. De Voy, assistant superintendent motive power, Chicago, Milwaukee & St. Paul, addressed the convention on Thursday morning.

In speaking of the federal boiler law he expressed the opinion that it has brought about a better condition of locomotive boilers, stating further that if the many regulations were governed entirely by federal permission rather than by state laws more practical results would be obtained, inferring that state legislatures do not consider these various regulations from a practical and enginering standpoint, as does the federal government. If in preparing laws for the regulation of various conditions in railway practice the advice of associations or practical men that are thoroughly versed in the problems under discussion is taken, much better results would be obtained.

Boilers of today, with their modern improvements, are performing five times the work of boilers over 20 years ago, and while the increased size of boilers has magnified faults which were thought of minor importance in the older types of boilers they have been developed to such an extent that they are fully as safe to operate, and are 25 per cent. more efficient insofar as economy is concerned.

ELECTION OF OFFICERS.

The following officers were elected for the ensuing year: President, T. W. Lowe, Canadian Pacific; first vice-president, J. T. Johnson, Santa Fe; second vice-president, Andrew Greene, Big Four; third vice-president, D. A. Lucas, Chicago, Burlington & Quincy; fourth vice-president, J. B. Tate, Pennsylvania; fifth vice-president, C. P. Patrick, Erie; treasurer, Frank Gray, Chicago & Alton.

Aviation Record.—A French aviator on May 18 flew from Hendon, England, to Calais, France, and back without landing, a total distance of 100 miles in 65 minutes, with one passenger.

Texas State Railroad.—Beginning on July 1, the Texas State Railroad, operating between Palestine and Rusk, Tex., will be operated under the jurisdiction of the governor instead of the State Prison Commission. Governor Colquitt has announced that he will assume the active management, and that instead of reporting a monthly loss he believes he will be able to make the road earn from $1,000 to $2,000 a month. The governor recently made an inspection trip over the road with President W. B. Scott, of the Sunset Central Lines, for the purpose of obtaining advice from a practical railway man. A number of improvements are contemplated.

CAR DEPARTMENT

UNDESIRED QUICK ACTION OF BRAKES

C. N. Remfry, of the Duluth, Missabe & Northern, read a paper at the recent meeting of the Air Brake Association on "Undesired Quick Action, Its Prevention and Remedy," an abstract of which follows:

We have 7,000 ore cars and 2,000 freight cars on our road. The ore equipment does not leave our system, therefore it is under observation throughout the year; when the ore season is at its height each car will average one round trip of about 190 miles every 24 to 36 hours, and is examined by air inspectors after each trip. This equipment is in service only during the time that navigation is open on the great lakes, approximately from April 15 to November 30, and at the close of the season the brakes are cleaned and lubricated, and the cars stored for the next season's work.

Prior to and including the year 1906, triple valves were cleaned on the cars. We simply removed the triple cap and the check valve case, wiped the parts as clean as possible, applied triple valve oil to the slide valve and slide valve piston, then replaced the parts, after which the brakes were tested for leaks and defects. Under this method the brakes worked in first-class condition when cars were put in service at the start of the season's work, generally during the month of April, and continued giving good service while the weather remained cold. During the latter part of May when the weather became warmer, undesired quick action developed on nearly all trains.

We worked on the theory that in warm weather the oil or grease became thinner and settled to the bottom of the triple piston cylinder carrying grit, dirt and rust with it, that this foreign substance moved back and forth with every movement of the piston, and that at times small pieces would wedge between the packing rings and bushings, holding the piston until the pressure became great enough to move the piston past the obstruction, and that when it did finally move, it went to emergency position, throwing the entire train into emergency.

To overcome the undesired quick action it was recommended that triples be cleaned in a warm place, that the highest grade of lubricant possible to secure be used, that train pipes be hammered to loosen rust, scale, etc., and that the pipes be thoroughly blown out. The suggestion was followed out to the letter. Upon starting trains in the spring the undesired quick action developed immediately and lasted throughout the season of eight months, regardless of whether weather conditions were hot or cold. Delays came in from all sides, drawbars pulled out, and in general the equipment became more or less weakened; in fact, repair tracks and storage yards were filled with bad-order cars. I do not hesitate to say 20 per cent. of our equipment was out of commission. The only explanation a train crew had to make for a break-in-two or a delay was "dynamite train."

Upon examining the triple valves at the end of the season, we found the lubricant on the triple valve slide valves and pistons in about the same condition as when the brakes were cleaned, with very little grit on the pistons or bushings. The matter was referred to the Westinghouse representative in our district, and a large number of suspicious triple valves which he selected from trains developing undesired emergency action were sent to the Westinghouse works at Wilmerding, Pa., for closer examination and test purposes.

Before the opening of the 1909 season and before any ore car brakes had been overhauled, recommendation was made not to hammer the pipes, but to simply blow them out, to give special attention to the cleaning of the triple valves, gasolene to be used where we previously used kerosene to remove grease, gum and dirt from the parts of the valve, and for lubrication we were instructed to use a high-grade, fine dry graphite on the slide valves and a good grade of grease or oil on the triple piston. When the season opened all brakes on ore equipment had received this treatment, and at the end of the season or after running eight months, we had only six cases of undesired quick action, and in each case the triple valve causing the trouble was located and found to have oil on the slide valve.

The following tabulated list of trains handled during the last six years will give an idea of the trouble experienced while we used oil or graphite grease on slide valves and the results obtained from changing to dry graphite:

Year.	* Trains south with loads.	* Trains north with empties.	** Emergency trains reported.	Cause.
1907	6,878	6,672	375	
1908	4,021	3,897	4,021	
1909	5,946	5,625	6	Found lubricant on slide valve in each case.
1910	5,929	5,653	0	Mechanical defect. Wings of slide valve riveted too tight, causing graduating valve to bind.
1911	3,092	2,898	1	
1912	4,536	4,347	0	

* Hill trains not included.

** Trains developed undesired quick action more than once during the trip. No record kept of the number of times undesired quick action took place. No record kept of the cars in each train. It is assumed that a large percentage of the trains contained almost the same identical cars, therefore it is safe to say that the list includes trains which developed this trouble several times but on different trips.

It is safe to say the undesired quick action experienced on the hill was more severe than on the road, especially on the down trip while trains are controlled with the retaining valves. To make the down trip, including the stops at docks, about eighteen service applications are made, while in road service it is not necessary to make so many, the average being about four applications.

Even at the present time our commercial trains, those handling regular mixed freight, quite frequently show undesired quick action. This can only be explained by the fact that these trains contain a number of foreign cars, brakes of which are lubricated with oil instead of dry graphite.

It was also found that the type of triple valve had no effect one way or the other with producing or remedying the undesired quick action. The last change we made which had a bearing on this subject was in the brake cylinder lubricant. On the majority of our ore cars, the brake cylinder is located on the side of the car instead of being located under the car or under the end hopper sheets where it would be shaded in warm weather. Owing to this exposed location the brake cylinder lubricant, which was a heavy grease, became thinner, making it more penetrating, and the possibility of its working back to the slide valve through the exhaust port, thereby destroying the benefits we expected to obtain from doing away with oil or grease on this part of the valve, was a question we had to take into consideration. In 1909 a trial was made of a lubricant that does not appear to be affected by heat or cold, which has since been made the standard.

Foremen and men cleaning triple valves are compelled to observe the following instructions:

INSTRUCTIONS TO TRIPLE VALVE CLEANERS.

1. Remove triple cap, triple piston and slide valve. Place piston and slide valve in a can of gasolene, completely immersing the parts.

2. Remove check valve case and its parts.

3. Clean piston bushing with cheese cloth and gasolene, clean the slide valve bushings with cheese cloth wrapped around a

stick and used as a swab, which has been soaked in gasolene, after which wipe all parts dry and blow out all ports with air.

4. Remove triple piston and slide valve from gasolene, wipe dry and blow out all ports and blow off all parts.

5. Apply graphite to chamois skin glued to a flat stick and rub graphite well into slide valve face, bushing seat and top of slide valve bush along the place where slide valve spring bears. Triple piston is to be replaced in the triple valve, the triple piston bushing being dry, after which a few drops of oil are to be applied to the bushing and be spread with the finger and the piston worked back and forth a few times. This method of lubricating triple piston bushing is to eliminate the possibility of any surplus oil working back on the slide valve, as may occur should the triple piston bushing be lubricated before the triple piston is put in place. Then put on the triple cap.

6. Select a check valve case which has had the valve ground in, wipe all emergency parts dry and apply. Check valve case is not to be applied until triple cap has been put on and tightened up. This is to prevent any graphite which may drop off the slide valve when it is applied, from dropping into check valve case.

7. All triple valves must be tested on Westinghouse improved test rack.

In conclusion the points I wish to emphasize are (1) that with brake maintenance second to none, we had a serious epidemic of undesired quick action each year until we finally changed our method of cleaning and lubricating triple valves to the one just described; (2) that since then we have had practically no undesired quick action; and (3) that the effect on slide valves and their seats has been, as far as we can see, distinctly helpful, as indicated by less leaky slide valves.

DISCUSSION.

The members generally participated in the discussion, many stating that they had not obtained as good results by the use of dry graphite as Mr. Remfry had. This is due to the fact that dry graphite is not generally used by all the roads, the greater percentage of the trouble being experienced from foreign cars not using this material. Among other causes pointed out as giving the undesired quick action, J. P. Langan (D. L. & W.) mentioned the inability of the feed valves to keep up with excessive train pipe leakage. He also stated that when the air cylinder of the compressor was lubricated by the automatic lubricator he found that the whole air system would be liable to become flooded with oil. If this system is to be used extreme care should be taken to see that the lubricators are handled correctly. He also stated that a leak in the train line somewhere near the triple valve would often give the undesired quick action.

C. W. Martin (Pennsylvania) spoke of the difficulty many roads would experience in the use of gasolene, due to the insurance restrictions, stating that he had found kerosene to do very nicely, but in this regard it was shown that extreme care must be taken to see that the kerosene was thoroughly wiped off, as it would not evaporate as readily as gasolene.

An interesting point was mentioned by F. Von Bergen (N. C. & St. L.) who stated that he had experienced trouble with triple valve bushings that had been re-rolled; he believed all such repairs should be done by the manufacturing company to insure its being done correctly.

G. H. Wood (A. T. & S. F.) stated that although he had used dry graphite, he had not found it to wholly solve the problem; trains out of Chicago would operate satisfactorily until they got down into the hot climate of Arizona, where the undesired quick action would take place, seemingly due to moisture in the train line.

Most of the speakers could not report continued success by the use of dry graphite, stating that the oil in the brake cylinder would work back through the exhaust ports to the triple valve and that moisture from the train line would find its way to the slide valve.

Walter V. Turner (Westinghouse Air Brake Company) explained that when either water or oil found its way to the triple valve slide valve seat, the advantages of the dry graphite were wholly nullified. The purpose of the dry graphite is to allow the air to percolate under the slide valve, thereby reducing its bearing pressure on the valve seat so that it will respond to a small difference in pressure between the auxiliary reservoir and the train line. He also stated that any dirt or other substance that would tend to cause the slide valve to stick would allow the pressure to accumulate on one side of the slide valve so that when the resistance was overcome, the slide valve would not respond to the graduating spring and would move to the emergency position.

It was the consensus of opinion that while dry graphite would greatly reduce the causes of undesired quick action there were many other things to be considered as well, and so long as different roads used different methods in caring for the triple valve there could be no uniformity in its operation.

MARKING COUPLERS AND PARTS

A paper on "Couplers and Parts, Marking by Manufacturers for Identification" was read by A. H. Young, St. L. & S. F., at the annual meeting of the Railway Storekeepers' Association. An abstract follows:

At present we have about forty different types of couplers and the number is increasing, although it is several years since the Master Car Builders' Association took up the question of designing and adopting a standard M. C. B. coupler. Considerable progress has been made in this matter during the past two years, but even though a standard coupler is adopted at the next meeting of the Master Car Builders' Association, we still have the present numerous types of couplers to maintain until the bodies are either worn out or scrapped.

From an economical standpoint, the question of supplying repair parts for so many different kinds of automatic couplers should be a strong argument in favor of a single standard. The storekeepers are interested in this matter because it means not only less delay and less trouble in making repairs to foreign equipment, but will bring about a reduction of several thousand dollars in the amount of repair parts now necessary to be carried in stock.

As we must maintain the present styles of automatic couplers for several years at least, I believe we should take some action to have all coupler parts marked in such a manner that they may be quickly and correctly identified. This can no doubt be accomplished without adding any expense to the manufacturer, or much trouble to the Storekeepers' or Master Car Builders' Associations, by compiling a complete list of all couplers now in use, assigning a number to each coupler with the parts classified under the proper heading and designated alphabetically; the coupler number with the alphabetical prefix to be cast in each piece by the manufacturer.

If all coupler parts were made with this identifying mark, it would enable the storekeeper or car department foreman to use the cheaper labor on his force to handle this class of material without the assistance of experienced and higher-priced workmen, because any laborer who could read the number would be able to tell at once the coupler to which any part belonged and could assort a shipment of mixed knuckles or locks just as readily as the most experienced car repairer.

Discussion—All the members speaking on this subject recognized its importance and urged that prompt action be taken. It was believed that the Storekeepers' Association could handle it with assistance or co-operation with other associations, and a committee of three was appointed to draw up a list of all parts with recommended designating numbers, which should be in shape to be put in effect immediately on adoption at the next meeting.

WILL TRIPLE VALVES OPERATE AS INTENDED?

Effect of Different Sizes of Brake Pipe, Main Reservoir Pressures, Compressor Capacity, etc.

S. W. Dudley, of the Westinghouse Air Brake Company, prepared a paper on this subject for the annual meeting of the Air Brake Association. In his absence it was read by W. V. Turner. An abstract follows:

The triple valve is built to operate in a certain manner when the total pressure on the brake pipe side of its piston differs from that on the side next the auxiliary reservoir by a certain amount. Consequently, it will so operate whenever the predetermined condition exists, regardless of how this condition may be brought about. From this point of view and with the triple valve in proper condition, it can never operate improperly.

The successive stages in the advance of the air brake art in the direction of higher efficiency, economy and safety have received ample attention from time to time. The papers, and the discussions in connection with these papers, have necessarily involved much reference to the effect of conditions of apparatus, installation, maintenance, proper and improper manipulation and so on. But an account of the influence of these circumstances, especially on the service operations of this brake, does not appear to be available in a form convenient for reference or study. Consequently it seems both fitting and of value to the association to present for discussion and record the results of a somewhat comprehensive series of tests along these general lines which were conducted jointly by representatives of the Pennsylvania Lines and of the Westinghouse Air Brake Company.

They were made to determine, comparatively, the effect of the more common circumstances affecting the service operation of the triple valve in modern passenger train service. A primary consideration was the relative effect of 1 in., 1¼ in. and 1½ in. brake pipe on the release, the service and the emergency functions of the quick action triple valve. Other considerations were the effect of main reservoir pressure, compressor capacity, design of triple valve, kind of service brake applications, use of full release position, single and double brake equipment per car, condition of triple valve, rate of recharge of auxiliary reservoirs permitted and brake pipe leakage.

The tests were made on a 12-car train test rack of double PM-1612 equipments, including one complete No. 6 ET locomotive brake equipment, located out of doors at the plant of the Westinghouse Air Brake Company, Wilmerding, Pa. The apparatus was arranged so that any desired combination of conditions with regard to compressor capacity, size of brake pipe, arrangement of equipment or manipulation could be readily obtained. Standard (not extra heavy) pipe was used in all cases. The test rack duplicated, as nearly as possible, train service conditions. Whether or not the present service demands are in excess of the capacity of the ordinary quick action triple valve in other particulars than the releasing of the brakes was not considered at all in these tests, this being entirely foreign to the present investigations.

Previous to this series of tests the triple valves (originally taken from storeroom stock in good condition but without special attention being given them) had been operated on the rack more or less for about two weeks. Just preceding the tests each valve was tested on the triple valve testing rack. The records of these tests show that the valves were by no means in a uniform condition. Some were sensitive to application and some were not, and similarly some were sensitive to release and others required a considerable differential before releasing. No change, however, was made in any of the valves after they were tested on the triple valve test rack, as it was the opinion of all that to allow the valves to remain as they were would more nearly approach service conditions than to have them all in the best possible condition. Preliminary tests showed that as the triple valves stood, the use of 1½ in. pipe instead of 1 in. pipe did not appreciably change the number of brakes which would apply or release.

By the use of a portable brake testing truck after these preliminary tests the triple valves were tested individually and in a number of cases were found to require an excessive pressure to cause them to apply or release. It was evident that this was not the condition necessary if the influence of different sizes of brake pipe was to be accurately determined. The triple valves not passing a predetermined minimum test were accordingly replaced by others which would pass such a test and the experiments then continued with all of the triple valves in as nearly a uniform condition as could be accomplished without taking any extraordinary pains.

But few brakes failed to release with triple valves in good condition. To have triple valves in such a condition that they would fail to release was to introduce a disturbing factor (namely, the condition of the triple valve), which made impossible a fair comparison of the effect of size of pipe, etc. In the present instance the rate of rise of brake pipe pressure on the last car in the train was chosen as a convenient and satisfactory standard of comparison because it is directly and primarily affected by the conditions which it is desired to compare, it varies through a sufficiently wide range to permit of ready and accurate observation and because, with triple valves in like condition, the more rapid the rate of rise of brake pipe pressure on the rear car, the more prompt and certain will be the release of the brakes.

SIZE OF BRAKE PIPE.

When releasing brakes and increasing the pressure in the brake pipe, a 1½ in. pipe produces no improvement, and on the whole is less satisfactory than a 1¼ in. pipe in this respect. The time to increase the brake pipe pressure 5 lbs. on the last car in the train is practically the same as with 1¼ in. pipe. The difference in brake pipe pressure at the front and rear ends of the train during release is materially less than with the smaller sizes of pipe, which tends towards a greater uniformity of release of all the brakes in the train, other conditions being equal. With the triple valves in the non-uniform conditions already mentioned it was observed that the use of 1½ in. pipe instead of 1 in. pipe did not appreciably change the number of brakes which would apply or release.

The effect of 1½ in. brake pipe in service applications is to considerably delay the time of obtaining full brake cylinder pressure corresponding to the reductions made on the train as a whole, but at the same time cause a more uniform starting of the application of all the brakes. With a 1½ in. brake pipe, the time to start the application of the brakes on the twelfth car is practically the same as for the 1 in. and 1¼ in. The average time to obtain maximum pressure in making a 20 lbs. reduction with the 1½ in. pipe is 24.6 seconds, which is 5 seconds (or 25 per cent.) longer than for the 1¼ in. pipe and 10 seconds (or 70 per cent.) longer than for the 1 in. pipe.

While the use of a 1½ in. pipe slightly increases the emergency brake cylinder pressure, it seriously interferes with the obtaining of serial quick action especially with the brake (both triple valves) on the car next behind the locomotive cut out. The brake cylinder pressure in emergency is increased 6 lbs., or 7.7 per cent. above that obtained with the 1 in. pipe and 4.5 lbs., or 5.8 per cent. above that with the 1¼ in. pipe. The time of transmission of quick action through the train is not appreciably affected. Quick action could not be obtained with a

single engine and train having one car at the head cut out, nor could it be obtained at all with a double header, no brakes being cut out. With a 1 in. pipe quick action could be obtained in all such cases. The 1½ in. pipe, therefore, offers no appreciable advantages over the 1¼ in. pipe and does introduce some distinctly undesirable features.

The record of the brakes released with the 1¼ in. brake pipe is slightly better than with the 1 in. pipe. Its advantages in this particular are so slight as to be negligible in comparison with the much more marked differences produced by the use of other means, such as heavier brake pipe reductions, higher main reservoir pressure, etc., to be referred to in detail later. The time to increase the brake pipe pressure 5 lbs. on the last car is, under all conditions, less with the 1¼ in. pipe than with the 1 in. pipe. This should result in a corresponding improvement in releasing brakes. The summary of the tests, representing conditions where some brakes are close to the "sticking point," shows that for the 1 in. pipe, out of a total of 432 possible stuck brakes 6.5 per cent. were stuck for 10 seconds and 3.7 per cent. stuck for 60 seconds. The substitution of a 1¼ in. pipe for a 1 in. pipe, other conditions remaining the same, reduced these percentages to 1.6 per cent. and 0.9 per cent. respectively. The percentages for 1½ in. pipe were 1.2 per cent. and 1.2 per cent. respectively, showing no appreciable gain over 1¼ in. pipe. However, on the whole, the difference between the effect of 1 in. and 1¼ in. pipe on the release of the brakes was not sufficient to indicate that the larger pipe would materially assist in releasing the brakes under otherwise unfavorable conditions. The difference in brake pipe pressure at the front and rear ends of the train when releasing is materially less than with the 1 in. pipe, tending towards greater uniformity in release, other conditions being equal.

The effect of a 1¼ in. brake pipe in service applications is to somewhat delay the application of the brakes on the train as a whole, but at the same time produce a more uniform starting of the application of all the brakes. With a 1¼ in. brake pipe the time to start the application of the brakes on the twelfth car is practically the same as for the 1 in. pipe. The time to obtain maximum pressure in making a 20 lbs. reduction is 19.6 seconds, which is 5 seconds (or 35 per cent.) longer than with the 1 in. pipe.

The use of the 1¼ in. pipe slightly increases the emergency brake cylinder pressure, but tends to hinder serial quick action. This interference with quick action, however, was not appreciable, except under the more severe conditions; which conditions were, however, not sufficient to affect the obtaining of quick action with the 1 in. pipe. The emergency brake cylinder pressure is increased 1.5 lbs., or 2 per cent. above that with the 1 in. pipe. The time of transmission of quick action throughout the train is not appreciably affected. Quick action could not be obtained (using one engine) with two cars (4 triple valves, two per car) cut out at the head end of the train, nor could it be obtained with a double header and one car cut out at the head end. With a 1 in. pipe quick action could be obtained in all cases.

The use of a 1¼ in. pipe would, therefore, tend toward improvement in releasing brakes, would be a distinct economic advantage (due to having but one, instead of two standard sizes of air brake hose and fittings to be kept in stock and handled) and would not be objectionable, either on account of a slower service application or its effect on quick action except under extreme conditions. However, it could not be expected to entirely eliminate the troubles heretofore experienced with double equipment cars, other conditions remaining unchanged, and is of much less benefit than a number of the other factors, such as manipulation, main reservoir pressure, and so on mentioned in this report.

General Conclusions.—As would be expected, with low main reservoir pressure and short time in full release position, there is not much difference in the results with different size pipe, but with the higher (140 lbs.) main reservoir pressure the effect of large size pipe is marked. With 140 lbs. main reservoir pressure, for all reductions and times in full release position, the difference between the brake pipe and pressure on car 1 and on car 12 with 1¼ in. pipe is half or less than half that with 1 in. pipe. With other conditions the same, the 1¼ in. pipe permitted the brake pipe pressure on the last car to rise to a higher point than did the 1 in. during the time the brake valve handle is in full release position.

The average time to start the brakes applying varies but a few tenths of a second for all different reductions and different sizes of pipe. That there is no particular difference in this respect under extreme conditions is shown by the fact that the average time to start the application is the same (3.8 seconds) for the 6 lbs. reduction and 1 in. pipe and for the 20 lbs. reduction and 1½ in. pipe.

The average time to obtain maximum brake cylinder pressure is materially longer, the larger the size of pipe. The time to obtain maximum pressure in making a 20 lbs. reduction with 1½ in. pipe in 24.6 seconds, which is 5 seconds (or 25 per cent.) longer than for 1¼ in. pipe and 10 seconds (or 70 per cent.) longer than for 1 in. pipe. With 1¼ in. pipe this time is 19.6 seconds, or 5 seconds (35 per cent.) longer than the time when using 1 in. pipe, viz., 14.5 seconds. The tests showed that for

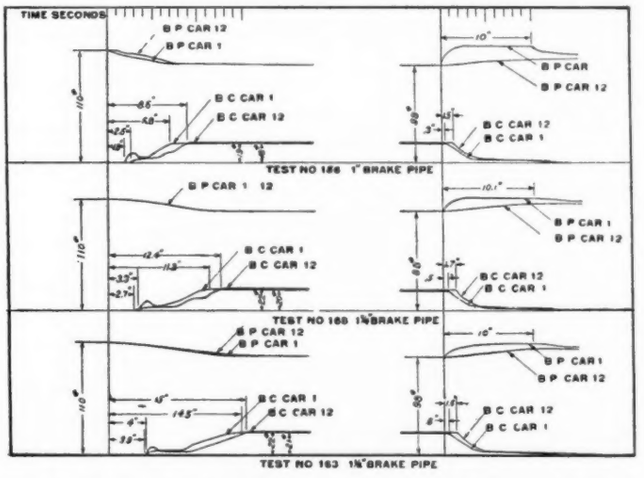


Fig. 1—Comparative Promptness, Uniformity and Rate of Fall of Brake Pipe Pressure and Rise of Brake Cylinder Pressure During Service Application and of Rise of Brake Pipe Pressure and Fall of Brake Cylinder Pressure During Release.

1 in., 1¼ in. and 1½ in. brake pipe.
Equipment double PM 1612.
Brake pipe reduction 12 lbs.
Brake valve handle in full release 10 seconds.
Main reservoir pressure 140 lbs.
Compressors—One 9½ in. M. R. volume 60,000 cu. in.

a 20 lbs. reduction the maximum time to obtain maximum cylinder pressure with 1 in. pipe (15.8 seconds) is 2.2 seconds shorter than the minimum time with 1¼ in. pipe and 7.2 seconds shorter than the minimum with 1½ in. pipe.

Figs. 1 and 2 show clearly that with a 1 in. pipe there is a greater difference between the brake pipe pressure on the head and rear end of the train during service application of the brake than with the larger size of pipe. They also enable a direct comparison to be made of the considerably increased time required to make the same brake pipe reduction with the larger size pipe. In releasing, these brake pipe cards show a much greater rise in brake pipe pressure on the first car than on the last car, the difference being less, however, as the size of pipe increases. Moreover, they show the characteristic slow rate of rise of pressure on the last car. The much slower brake application with the larger size pipe follows the slower fall in brake pipe pressure. The difference in time of obtaining brake cylinder pressure on the first and twelfth cars, all the way up until

the maximum is reached, is practically the same for the different sizes of pipe.

The brake cylinder release cards are practically identical for the different sizes of pipe. In the case of the equipments from which these cards were taken it is evident that the release was prompt under all conditions, the release on Car 1 being commenced in a half-second or less, and on Car 12 within about a second and a half or less than two seconds at the most. Evidently, where triple valves are releasing in the manner illustrated on these cards, the leaving of the brake valve handle in release for six seconds, ten seconds, or fifteen seconds, cannot possibly have any effect on the release of the brakes. That all do not always release thus, however, is also indicated by the test data previously referred to.

The time of transmission of quick action is but little affected by the size of pipe. The difference in time of transmission of quick action when the pipe is increased from 1 in. to 1½ in. is not appreciable. With 1 in. pipe three cars had to be cut out at the head end before quick action would fail. When a car brake is spoken of as being "cut out" it is understood that both equipments on the car having double equipment are cut out. With 1¼ in. pipe on cars and a single engine, with either 1 in. or 1¼ in. pipe on tender, quick action failed with two cars cut out and with double header quick action failed with one car cut out. With 1½ in. pipe on the cars quick action failed

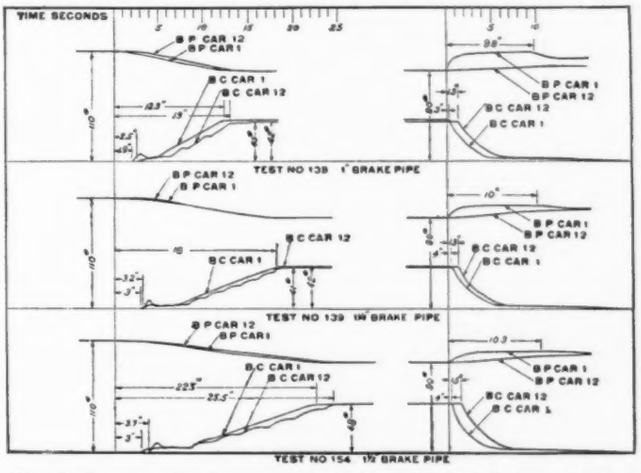


Fig. 2—Comparative Promptness, Uniformity and Rate of Fall of Brake Pipe Pressure and Rise of Brake Cylinder Pressure During Service Application and of Rise of Brake Pipe Pressure and Fall of Brake Cylinder Pressure During Release.

1 in., 1¼ in. and 1½ in. brake pipe.
Equipment double PM 1612.
Brake pipe reduction 20 lbs.
Brake valve handle in full release 10 seconds.
Main reservoir pressure 130 lbs.
Compressor—One 9½ in. main reservoir, volume 60,000 cu. in.

with the single engine and one car cut out and with the double header quick action could not be obtained at all, no brakes being cut out.

The effect of different size of pipe on the cylinder pressure obtained in emergency application is as follows: With the 1¼ in. pipe 79.5 lbs. is obtained or only 1½ lbs. higher average emergency cylinder pressure than with the 1 in. pipe (78 lbs.), and with the 1½ in. 84 lbs. is obtained, which is 6 lbs. higher than with the 1 in. pipe. This is in proportion of 1 to 1.02 to 1.08. The increase in volume of pipe is approximately 1 to 1.73 to 2.38. It is not to be expected, however, that the emergency brake cylinder pressure should increase in the same proportion as the brake pipe volume, because the emergency pressure depends in a large measure on the auxiliary reservoir volume which remains constant and is much greater than the volume of the brake pipe. The release after an emergency application is noticeably longer for the larger size of pipe.

MAIN RESERVOIR PRESSURE.

A high main reservoir pressure at the time the release is made is one of the most effective aids in overcoming troubles from stuck brakes. With 130 lbs. main reservoir pressure, 10 seconds in full release, there was a total of 20 brakes stuck for 20 seconds and 13 stuck for 60 seconds in all tests with all sizes of pipe. With 140 lbs. main reservoir pressure, all other conditions the same, not a single brake failed to release within 10 seconds. With 140 lbs. main reservoir pressure the time to increase the brake pipe pressure 5 lbs. on the last car varied from 4 to 12 seconds under conditions and methods of manipulation varying from most to least favorable. With 130 lbs. main reservoir pressure this time varied from 6 seconds to 30 seconds, the longer time being due to the recharge being incomplete at the time the brake valve handle was returned from full release to running position, requiring the latter part of the increase in brake pipe pressure to take place through the feed valve, at which time the feed valve rather than the size of pipe would be the governing factor. With 120 lbs. main reservoir pressure this time varied from 8 seconds to 68 seconds, the excessively long time being due to the still greater effect of the feed valve as just explained.

COMPRESSOR CAPACITY.

That this high main reservoir pressure must be available at the time the release is made follows as a matter of course. In carrying on such tests as these it was necessary to wait until the air compressor had raised the main reservoir pressure to the proper point before releasing. With the single 9½ in. compressor used in most of the tests this time was usually only ten seconds and never over 15 seconds, and a special test would have been required to show satisfactorily the difference between an ample and an insufficient compressor capacity. It goes without saying, however, that the maximum main reservoir pressure necessary in order to insure satisfactory releasing of the brake will be more certain the greater the compressor capacity, especially in view of the many influences that are likely to combine to prevent the utilization of the maximum compressor capacity which would otherwise be available under favorable conditions. The few tests which were made with two compressors instead of one were sufficient to show the less burden imposed on each compressor when two were used and the very desirable increase in reserve capacity to take care of abnormal conditions.

BRAKE APPLICATIONS.

One of the most impressive results of the tests was their consistency throughout with the principle that the brakes can be released with greater certainty after a heavy brake pipe reduction than after a light reduction. The differential, or "driving head," with a light reduction, is smaller and consequently cannot force the air back through the brake pipe and increase its pressure as promptly as the higher differential available when the reduction is heavier. It is the light brake pipe reductions that cause the most trouble. Few brakes stick after a 20 lb. reduction, and those that do require attention, as it is internal and not external conditions that are responsible. But it is not always feasible to make heavy service reductions. There are likely to be times when there is some doubt as to whether a reduction sufficient to insure the possibility of subsequently releasing all triple valves may not be heavier than necessary, or perhaps desirable. Judgment alone can decide what is best to be done in such cases. Considered broadly, such results indicate that whenever a low retarding force is necessary it should not be possible to obtain this with brake pipe reductions less than will permit of a reasonably certain release of the brakes under otherwise average conditions.

TIME FOR RELEASE.

The tests show that so long as the time to recharge the brake pipe sufficiently to release all normally operating triple valves

exceeds the time that the brake valve handle is ordinarily left in release position there is a greater tendency for the less sensitive triple valves to fail to release. In such cases the longer the brake valve handle is left in full release position the quicker is an increase of 5 lbs. at the rear end obtained. Consequently, the greater is the likelihood of releasing brakes which otherwise would stick. However, they show that with the longer time in full release position there is also a greater tendency to overcharge the system and thus invite evils of a different sort.

To leave the brake valve handle in full release longer than six or eight seconds does not necessarily insure releasing brakes which would stick with a shorter time in full release position. Whether the brake valve handle is in full release position six seconds, or ten seconds, or fifteen seconds, the rate of rise of brake pipe pressure for the first six seconds is the same in each case and the great majority of triple valves that are going to release at all will have released before this time, and those that have not released usually will remain "stuck."

Furthermore, the tests in general showed that no fixed rule for the time the handle should be left in full release position can be laid down arbitrarily, with the expectation of obtaining the best results in all cases. This depends largely on a proper judgment of the influence of the various factors involved, such as length of train, amount of reduction, main reservoir pressure and volume, etc., although in some instances it will doubtless be possible for those intimately familiar with existing conditions in any particular territory to formulate general instructions which will be of considerable service.

SINGLE AND DOUBLE P-M EQUIPMENTS.

The brake pipe can be recharged much more quickly and, therefore, the triple valves released with much greater certainty when using the single equipment. This simply amounts to saying that it is harder to recharge a pipe with two outlets of a given size, each leading to a large auxiliary reservoir, than if there were only one outlet. The difference between the two cases was considerable. In no instance with the single equipment did the time to increase the brake pipe pressure on Car 12 5 lbs exceed 5.2 seconds, as compared with a maximum of over a minute when conditions with the double equipment were unfavorable. This is very clear evidence of the reason why long trains or trains having large auxiliary reservoir volumes to be recharged by P-2 triple valves give so much more trouble on the road than was experienced before the brake pipe was subjected to such an excessive drainage.

AUXILIARY RESERVOIR RECHARGE.

The difference between the results obtained with single equipment cars in short trains and with double equipment cars on long trains with large reservoirs is proportional to the difference between the amount of air which can be permitted to flow into the brake pipe and the amount which is able to flow out from the brake pipe. As the rate of inflow is fixed by many considerations the question naturally arises: Why not limit the rate at which air can leave the brake pipe to an extent which will permit of always obtaining a sufficiently rapid rate of rise of brake pipe pressure to positively insure a release of all triple valves? This is perfectly logical, and, in fact, is what is done in the more recently designed apparatus.

But with the quick action triple valve there is only one way in which this can be accomplished, viz., restrict the rate at which the auxiliary reservoir can be recharged by reducing the opening from the brake pipe to the reservoirs. For convenience in making a test to show what could be gained by such a modification, the slower rate of charging the auxiliary reservoirs was accomplished by inserting a check valve in the pipe leading from the triple valve to the auxiliary reservoir, having a small hole drilled through the check valve proper of a size suitable for the rate of recharge desired. The check valve opened freely in the direction of the triple valve so that it offered no restriction to the flow of air from the auxiliary reservoir. When arranged to give the minimum permissible rate of recharging (viz., that of the present P-2 triple valve and the largest size auxiliary reservoir—16 in. x 42 in.—with which it is being used in regular service), it was found that the use of these check valves very materially diminished the time required to increase the brake pipe pressure on the last car 5 lbs., and thereby the condition of the single installation on a short train with small volumes to be handled is more nearly approached.

Under unfavorable conditions the charging of the brake pipe at the rear end of the train was increased nearly as much as under the most favorable conditions without the chokes and with the chokes, the use of 1¼ in. pipe instead of 1 in. pipe produced no appreciable effect, so far as the increase in brake pipe pressure on the rear was concerned.

The use of such check valves or their equivalent would, therefore, assist in obtaining a quicker recharge of the brake pipe and so tend to diminish troubles due to stuck brakes. This conclusion in itself, however, is only one side of the story. There are several other considerations involved, two of which may be mentioned briefly. Difficulty is always experienced in keeping the ordinary check valve tight, especially with relatively low differentials of air pressure, and questions of installations and maintenance then arise, which would require a trial and close observation before the service efficiency of such an expedient could be determined. The question of what improvement could be expected from such an expedient is, therefore, one of design or modification of existing apparatus, to suit specific conditions. Again, as a general proposition, any slower rate of recharging of auxiliary reservoirs in passenger service than exists at present is undesirable. It is too slow now and the tendency of service requirements and of modern equipments is all towards a quicker rather than a slower rate of recharge. A reservoir not charged is useless for braking purposes. A prompt release of the brakes, therefore, requires a prompt increase in brake pipe pressure, which in turn, cannot be accomplished if the auxiliary reservoirs are being recharged from the brake pipe at the same time that the release is being made. But the recharging of the reservoirs cannot safely be restricted. The difficulty is now that there is but little margin which will permit of making re-applications as frequently as is often necessary and to slow up the rate of recharging of the reservoirs would make this margin still less. These opposite requirements would be satisfied only by, first, preventing the recharging of the reservoirs from the brake pipe during the time the brakes are being released and by, second, recharging the reservoirs meanwhile from some source other than the brake pipe. This not only accomplishes the desired object, viz., prevents an excessive drain on the brake pipe, but also recharges the auxiliary reservoirs as quickly as the brake pipe alone can be recharged. In doing this the releasing of the brakes is insured to a maximum degree, because the brake pipe only (or with only a very small additional volume) has to be recharged in order to release. As a matter of fact, the result of this procedure is to enable the brake pipe pressure to be increased at a more rapid rate than at any other time in the history of the air brake.

Tests were made to ascertain if the use of 1¼ in. pipe on the engine in place of 1 in. pipe would have any effect on the transmission of quick action, both with a single engine and with a double header. No difference in the results could be detected.

To compare the effect of 1 in. and 1¼ in. pipe on the locomotive (1¼ in. pipe on the cars in each case) on the service operation of the brakes a series of 12 lb. brake reductions were made, the brake valve handle being left in full release position for 6, 10 and 15 seconds with both 120 lbs. and 140 lbs. main reservoir pressure. The results agreed so closely that no difference could be established one way or the other, either in the service application or release of the brakes.

The tendency of the larger size brake pipe is undoubtedly in the direction of permitting a greater amount of air loss by leakage without causing an application of the brakes. This merely amounts to saying that while a triple valve will apply on the same rate of drop of brake pipe pressure, the rate of drop with a larger brake pipe will not be as fast as with a smaller pipe for the same opening to the atmosphere.

OTHER DATA.

With the 1¼ in. pipe heaviest reductions and longest time in full release position, it was observed that during the time the brake valve handle was in full release position the brake pipe pressure at the rear of the tender was only 5 lbs. below that in the main reservoir. This showed that the H-6 brake valve opening was practically equal to the capacity of the 1¼ in. pipe and that a larger opening through the brake valve in full release position would be of no practical assistance, so long as larger than 1¼ in. pipe is not used.

DISCUSSION.

P. J. Langan (D. L. & W.) stated that he had found it impossible to make 5 lb. reductions without brakes sticking. Mr. Turner explained that that was on account of the large auxiliary reservoirs used on the D. L. & W., which allow the brake to set sufficiently to cause a stuck brake, there being enough pressure in the brake cylinder to make some appreciable brake application and too much pressure in the auxiliary reservoir to permit the triple valve to go to release position when the train line was recharged. With the smaller auxiliary reservoir this difficulty would be overcome.

COAL IN JAPAN.—The output of coal in Japan increased nearly 50 per cent. between 1905 and 1910.

GRAND TRUNK HOPPER BOTTOM BOX CAR

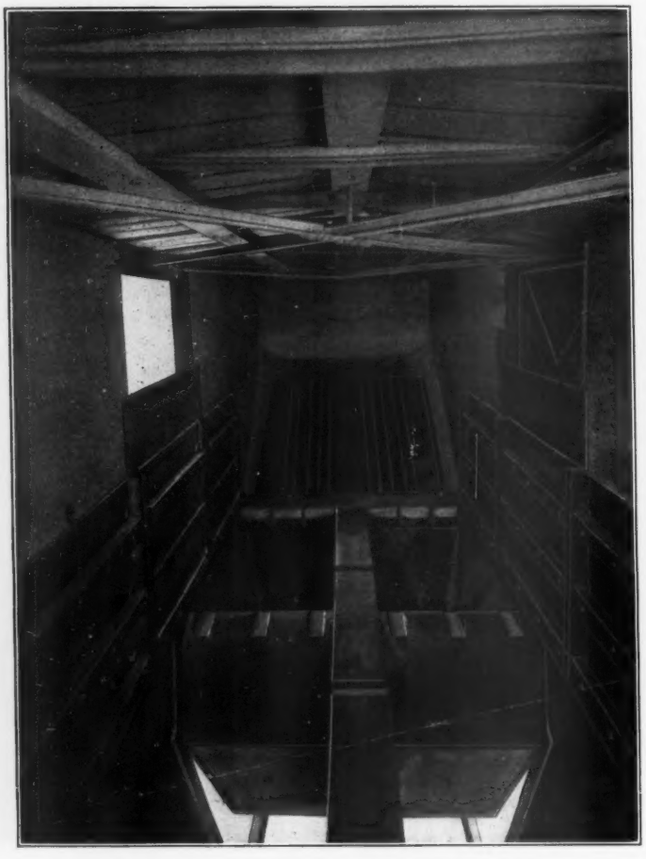
The Grand Trunk has had a box car in operation for about two years fitted with a hopper bottom for the rapid unloading of coal and other bulk freight. The construction of the car is similar to that of many of the steel frame box cars now in general use except that the center sills are considerably heavier. The hoppers slope from the center of the car and from both ends, the hopper doors being placed on either side of the side doors of the car. In order to determine the best type of door for the different kinds of freight handled, two different hopper doors have been tried out. One of these is a sliding door operated by a worm and gear and working against the load when opened; the other is a hinged drop door similar to those in general use on hopper bottom gondola cars; both of these doors are fitted with a specially designed grain tight joint.

Steel Frame Box Car Equipped with a Hopper Bottom.

When it is desired to use the car as an ordinary box car, doors are provided which are hinged to the side sill on the inside face of the hopper. When these doors are closed they are supported by the center sill and form a continuation of the car floor. When the hoppers are being used these doors are swung open and set flush against the inside face of the door posts, forming the grain doors. For oats or other light grain an extension piece is placed on the doors to enable the car to carry its full capacity.

The car was designed under the direction of James Coleman, superintendent of car department, Grand Trunk, and is being operated between Midland, Ont., and Portland, Me., carrying grain on the eastward trip and coal on the return trip. It has been found that to unload a car of grain through the hopper

does not require more than seven minutes, but it is believed that this time can be materially reduced, as when the test was made the grain elevator was found to be unable to take the grain into the receiving hoppers as fast as it was discharged from the hopper of the car, so that the latter would temporarily choke up. The following table gives some general



Interior of the Grand Trunk Hopper Bottom Box Car.

data of the car, as compared with the standard box car in use on the Grand Trunk:

	Hopper Bottom Box	Standard Box
Weight of car, lbs	48,000	37,000
Carrying capacity, lbs	110,000	66,000
Carrying capacity, bushels (wheat)	1,833	1,100
Total weight, car and lading	158,000	103,000
Tons carrying capacity per ton weight	2.29	1.73
Ton miles, tare, Midland to Portland	16,728	12,894
Ton miles, net, Midland to Portland	38,335	23,001
Ton miles, total, Midland to Portland	55,063	35,895

Coal Mine Accidents.—During the calendar year 1912 there were 2,360 men killed in and about the coal mines of the United States.

An Early Locomotive and Train.—The locomotive steam engine constructed by David & Garther, of York, Pa., commenced her operations on the Baltimore & Ohio Railroad under the most favorable auspices on Tuesday. It started from the Pratt street depot for Ellicott's Mills, with the entire train destined for that place, consisting of fourteen loaded cars, carrying together with the engine tender a gross weight of 50 tons. The whole train went off in fine style and was soon out of sight. A gentleman present says it was out of sight of the depot in about 6 minutes, and the rapid gliding of the immense train was one of the most imposing and beautiful spectacles he ever witnessed.—*From the American Railroad Journal, July 28, 1832.*

SELF-PROPELLED CARS*

BY S. T. DODD AND B. H. ARNOLD,
Engineering Department. General Electric Co.

The discussion is confined largely to the heavier types of independent cars, such as are suitable for steam trunk line and branch line service. The advantages of the internal combustion engine in operation, maintenance and radius of operation are so marked that the major part of the paper is devoted to this type of car.

STEAM CAR.

In summing up the position of the steam motor car, we note that of all the types which have been built, very few have been duplicated and none have been adopted as standard by operating roads in spite of the fact that they have been before the public for a length of time reasonably sufficient for their development. The objections which seem to have prevented their success are apparently: First, the cost of Maintenance. The necessity of developing a relatively high horse power in a limited space results in a special or cramped design of boiler and engine which is not economical in maintenance or repair. Next, the limited tractive power or excessive weight on drivers. The majority of cars of this type which have been built have the driving power applied to one axle only. Frequent stop service, for which the independent car should be particularly fitted, demands a high tractive effort in starting, if acceptable schedule speeds are maintained, and such tractive effort is not obtainable without a fairly high proportion of the weight upon driving axles. This results in excessive weight on the driving wheels when there is only one driving axle. Third, their limited operating radius. Tanks of 100 gal. of fuel and 1,000 gal. of water seem to be acceptable in practice. This represents a weight of fuel and water of nearly 10,000 lbs. and gives apparently an operating radius of only about 50 miles for fuel and 30 to 40 miles for water. For practical success, it appears that such a car should have an operating radius of about 100 miles without recharge.

STORAGE BATTERY CAR.

A storage battery car for branch line service, such as we have in mind, might fairly be assumed to have a weight of 40 tons and to require about 50 watts per ton mile for operation. This is equivalent to 2 k. w. per car mile, or for a run of 100 miles without recharging, would require a battery which would have a weight of about 10 tons or one-fourth the total weight of the car. These figures are presented to explain battery cars and to show that long distance operation of heavy cars without recharge of battery would entail a prohibitive weight of battery.

The writers wish to be clearly understood, however, that they believe that, on service which is within the scope of the battery, the storage battery car has a useful and economical field.

INTERNAL COMBUSTION ENGINE CAR.

Engines of the internal combustion type have been designed and built, which will use directly fuel in any of its three forms, solid, gaseous or liquid. The use of solid fuel, however, has not as yet been successful and gas fuels, while eminently satisfactory in certain cases, are practically prohibited by the conditions of motor car operation. The gas must either be carried compressed in tanks, or manufactured for immediate use in gas producers on the car. Both of these methods are subject to the same objections affecting steam and compressed air cars, as well as some additional ones.

The circumstances surrounding the use of liquid fuel are widely different. Internal combustion engines using this form of fuel are well and satisfactorily known and have reached a high degree of perfection. As an illustration of the economy of this type of fuel, it is to be noted that gasolene cars of 35 to 50

*Abstract of a paper read at the annual convention of the International Railway Fuel Association.

tons weight in actual operation on steam line service are carrying an amount of fuel which is equivalent to a radius of operation of 300 miles without recharging, and that including the weight of water for cooling the cylinders, the total weight of fuel and cooling medium does not exceed 2,750 lbs.

Mechanical Drive.—The best known development for passenger service has been the type of car built by the McKeen Motor Car Company. The first of these cars was built in 1905. In its latest development the standard car consists of a steel body 70 ft. in length with center entrance or side doors. In this car the designer has made the side of the car assist the floor beams in strengthening and stiffening the whole structure, making of the car floor and sides a composite girder, while the shape and location of windows and doors are subordinated to the requirements of strength. The exterior of the car, having smooth sides, pointed ends and a sloping roof, gives the general impression of being suitable for high speed service. The interior of the car is divided into an engine compartment and a seating compartment, either with or without smoker, baggage or express compartments. The passenger compartment may seat as high as 100 passengers. The gasolene engine which stands on the motor truck and swivels with it, is a six cylinder engine with 10 in. x 12 in. cylinders driving a crank shaft at right angles to the center line of the car. A sprocket is carried on this crank shaft which drives the forward axle, which has 42-in. wheels, through a chain drive by means of an air operated friction clutch. Two gear ratios are supplied and the air clutch throws in one or the other of these sets of gears, thus obtaining a slow speed and heavy tractive effort for starting, or a high speed for running. With either one of these gear ratios, the variation in speed from minimum to maximum is attained entirely by variation in engine speed regulated by the throttle and spark. With low speed gearing the full engine power is ordinarily attained at about 10 to 15 m. p. h., while with the high speed gearing, the full engine power is attained at the maximum running speed of the car. Maximum speeds developed by these cars are reported as high as 60-70 m. p. h. The cars are fitted with fuel tanks of 100 gal. capacity and weigh complete approximately 35 tons.

In addition to the McKeen cars, some other mechanical drive passenger cars might be mentioned, although they are less widely in use and of smaller commercial importance. Among others the Fairbanks-Morse Company, of Chicago, has built a mechanical drive gasolene car with single trucks, steel body and a seating capacity of 21. The P. H. Batten Company, of Chicago, has also built cars of this type with a seating capacity of about 30 passengers which are in operation on three roads in the central west. The Stover Motor Car Company, of Freeport, Ill., has supplied small single truck gasolene cars on the Waterloo, Cedar Falls & Northern and upon the Chicago, Rock Island & Pacific. The Hall-Scott Motor Company, of Oakland, Cal., has built double truck cars with a seating capacity of 50, and a 100-h. p. four-cylinder engine driving the rear axle through longitudinal transmission and double gears.

In Europe mechanical drive gasolene cars have been built by several companies and either are or have been in use on the Great Northern, England, the Swiss Federal Railroads, and the Wurtemburg State Railways.

Electric Drive—The fundamental difference between these cars and those discussed in the preceding section is that the engine drives an electric generator, and power is transmitted electrically to motors, geared to the driving axles, instead of the engine being connected directly to the axle by mechanical gearing. Of this type of car, the most extensive experience has been obtained in this country with the car manufactured by the General Electric Company.

On the latest type, the car body is built of steel and is designed for the combination of the greatest lightness and strength. The front end is rounded. Either center or rear entrance is supplied. The cars are built in lengths running from 40 to 70 ft. over-all, and weighing from 40 to 50 tons complete. The interior of the car is subdivided into passenger, smoker or second-class, baggage, and engine room. The width of the car is 10 ft. over-all. The cars have a seating capacity which may run as high as 95 or 100 passengers per car, depending upon the interior arrangement.

The power plant is located in the engine room at the front end of the car and consists of an eight-cylinder, 550 r. p. m., four-cycle gas engine of the V-type, direct-connected to a 100 k. w., d. c. generator. The generator is built essentially to meet motor car service and is, therefore, designed to carry a wide range of output in current or voltage, so that the output may be varied from 400 amperes at 250 volts to 125 amperes at 800 volts.

The trucks are an equalized swing bolster type, suitable for the high speeds obtainable with this type of car. One of these trucks is a motor truck, designed for carrying two driving motors. The other is a standard light trailer truck. The motor truck is generally placed under the forward end of the car and carries the weight of the engine room equipment in addition to the motors. In such a case as this, about sixty per cent. of the weight of the car is on the driving wheels. In some cases, however, the motor truck has been placed at the rear end of the car, under the passenger compartment, and in this case, approximately fifty per cent. of the weight of the car is on the drivers.

The car is equipped with two G. E.-205 100-h. p. railway motors. This is a commutating pole motor and is suited for wide variation in operating voltage. The gearing is specially selected for the service. The gear ratio is low enough so that the highest maximum car speed will not develop excessive rotative speed of the armatures; at the same time the ratio is high enough to obtain the requisite starting effort without imposing excessive overloads on the motors.

The car is designed for operation from one end only. The engineer's seat is located at the right hand front window of the engine room, and controller and throttle handles are placed directly in front of him. The controller is a convenient combination of engine and generator control, with the different levers placed vertically above each other and operating about practically the same center line. The engine generator set is started by admitting compressed air to the cylinders. This is done automatically on the first opening of the throttle. As soon as the engine turns over, and the first charge of gasolene is exploded in the cylinder, the air is automatically shut off. This type of car has demonstrated very marked advantages, and is in operation on a number of steam roads in various parts of the country. At present 50 of these cars are in regular daily service.

In Europe the most extensive experience with electric drive gasolene cars has been on the Arad-Csanad Railway in Hungary. This road has been operating gasolene electric cars since 1905. At the present time, they are running approximately 1,000,000 car miles per annum. Their records of cost of operation and maintenance on such equipments are probably more complete and extensive than any other railroad and show an average cost of maintenance of 2.5 to 3 cents per car mile. These cars were built by the French Westinghouse Company and recently the same type of car has been introduced into this country, in the car known as the "Dracar," built by the Drake Railway Automotrice Company, of Chicago. This company has already furnished five of these cars for the Missouri, Oklahoma & Gulf. The "Dracar" is 56 ft. long over bumpers and 9 ft. 6 in. in width. The car is divided into first-class, second-class, engine and baggage room compartments and the general scheme of control and utilization of electrical energy is substantially the same as previously described in connection with the General Electric car.

The storage battery is of no real value in combination with the electric drive, as it has been developed today. The real value

of the electric drive is the possibility of working through a wide range of voltage and current. With a storage battery auxiliary this advantage would be eliminated, as the generator would be forced to work at the constant voltage of the storage battery. The weight and cost of the battery is a considerable item and the same weight and cost could be expended to greater advantage in increasing the capacity of the engine and generator if necessary.

Comparative Characteristics—Comparing the characteristics of the mechanical drive gasolene car, and the electric drive gasolene car, the fundamental difference between them lies in the method of transmission of the power between engine and axle. The comparison of the characteristics is well illustrated in the curves of Fig. 1. These curves show the speed, tractive effort, and gasolene consumption of a car equipped with a 100-h. p. 550 r. p. m. gasolene engine, driving in the one case through electrical transmission, the motors geared to 38 in. driving wheels, and in the other case, through mechanical transmission, a single pair of driving wheels 42 in. in diameter. The slow speed gear reduction has been assumed at 7.5 to 1 and the high speed gearing at 1.6 to 1. These conditions correspond approximately to those ordinarily obtained on mechanical drive gasolene cars of this weight and capacity.

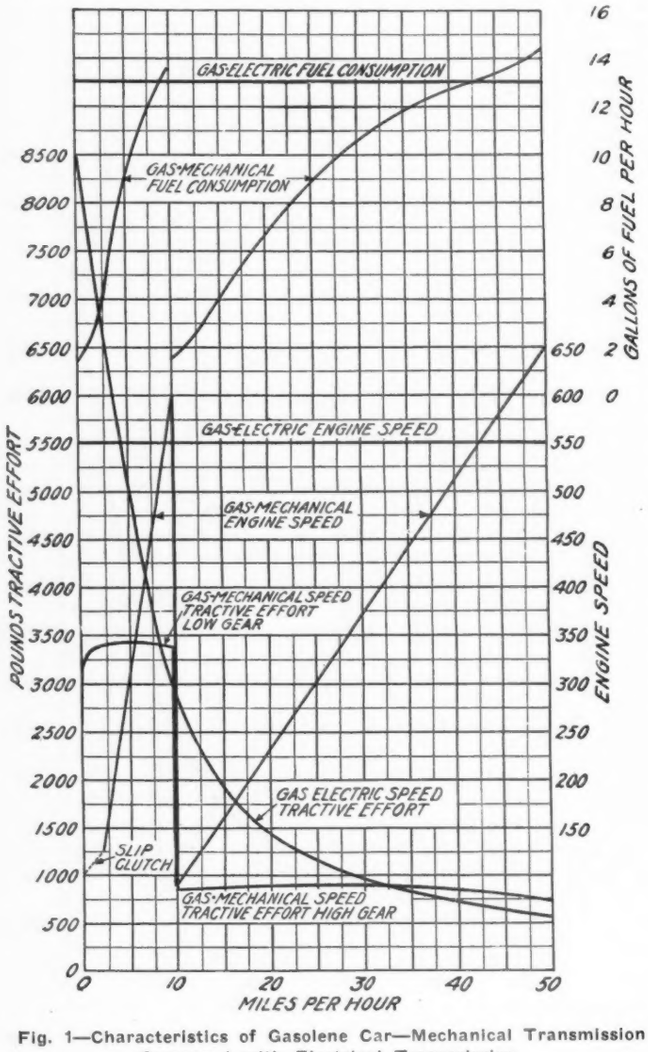


Fig. 1—Characteristics of Gasolene Car—Mechanical Transmission Compared with Electrical Transmission.

In the electric drive car the engine speed is independent of the car speed and is maintained at the normal value of 550 r. p. m. throughout the whole range of car speed. In the mechanical drive the engine speed is proportional to the car speed. It starts at a low value with the starting of the car, and increases with the car speed up to 600 revolutions at a car speed of 10 m. p. h. At this point the change gear clutch is thrown in, the engine speed is cut down to 100 r. p. m., with the higher gearing, and is again raised with the car speed to 650 r. p. m., at a car speed of 50 m. p. h.

The engine horse power is approximately proportional to the engine speed. With the electric drive the horse power is maintained at 100 h. p. throughout the range of car speed, but with the mechanical drive the horse power varies, reaching its maximum value at the maximum speed corresponding to the two gear ratios.

The electric drive car, on account of its constant horsepower output, develops a tractive effort which varies inversely with the speed. At any point the product of speed and tractive effort is constant. The mechanical drive develops a maximum tractive effort of 3,400 lbs. up to a car speed of 10 m. p. h. At this point, where the high speed gearing is thrown in, the tractive effort drops to 900 lbs., which is maintained approximately constant through the further range of car speed. Gas electric cars will in practice develop a maximum tractive effort of 10,000 to 14,000 lbs., depending on the gearing.

Fuel.—Gasolene and naphtha are the fuels ordinarily associated with the internal combustion engine for motor car service. These petroleum distillates are commercially graded and sold upon a gravity basis, using in general the Baume scale. The higher the gravity, the more volatile and desirable the distillate is assumed to be. This method of grading is inaccurate and misleading and where definite information is desired upon the characteristics of any distillate it must be superseded by a method based upon fractional distillation. If all other conditions were equal, the gravity would be a fair means of comparison, but at the present time when these distillates are obtained from petroleum of many fields and having different characteristics, it is a fact that gravity by the Baume or any other scale tells very little of the relative suitability of various gasolenes or naphthas.

Any one of the gasolenes embraces a number of compounds of different densities, and the hydrometer tells only the average density of the composition. The same gravity of a compound may be obtained either by straight distillation, or by blending very light distillates and heavy distillates in the proper proportions. While the gravity can be varied by proper blending, the boiling points of the components are unchangeable and by redistillation a blend can always be separated into its original components. In other words, by an examination by redistillation it is possible to accurately determine the composition of any gasolene or naphtha.

Utilization—In general, combustion engines utilize light distillates by means of an apparatus variously called a carbureter, vaporizor, or mixing valve. The action in this apparatus consists in breaking up the fuel into minute particles and thoroughly mixing it with air; for the best results the fuel should be so broken up as to be practically a vapor. The more volatile the fuel, the more easily it can be broken up and mixed with air. The nearer the boiling point of a compound is to its working temperature, the greater its volatility. Hence of any mixture the fractions of low boiling points are most easily volatilized and a knowledge of the boiling points of the various fractions is necessary to a knowledge of the behavior of the fuel as a whole. All of the fuel need not be of low boiling point, that is, easily vaporized; but there must be a sufficient percentage in order that starting will be assured. The remainder of the fuel must, however, be sufficiently volatile to be easily broken into a fog, or mist, and drawn into the cylinder without undue precipitation.

A knowledge of the boiling points is of much greater value in comparing relative suitability of the fuel than knowledge of the gravity. It is, therefore, recommended that the light distillates be specified and purchased by the boiling point method. By this method, the purchaser specifies the characteristics of

the fuel as determined by a fractional distillation test. Such a test consists in placing a certain quantity of liquid in a flask, vaporizing it, condensing the vapor and catching it in a graduate. The percentages of the original volume obtained at the various temperatures may then be plotted on curves as shown in Figs. 2 and 3, which are characteristic curves of gasolenes. If all conditions of petroleum composition and refining were the same the world over, gravity would then be a satisfactory means of comparison, for all curves would be of the same shape and parallel to each other as shown in Fig. 2, each curve representing a different gravity. Such, however, is not always the case, the true state of affairs frequently being as shown in Fig. 3. By the gravity method one would naturally expect a 72.5 deg. Baume gasolene to give better results than one of 63.6 deg. Baume, but in reality this particular 63.6 deg. Baume gasolene is much the better, as can be readily seen from the curves. This is contrary to the usual understanding and clearly indicates the fallacy of the gravity method of grading.

Specifications—It is a peculiar fact that all petroleum and petroleum products have practically the same heat value, 19,000 to 21,000 B. t. u. per pound, and as there is at present no suitable adulterant commercially practical, the heat value of petroleum

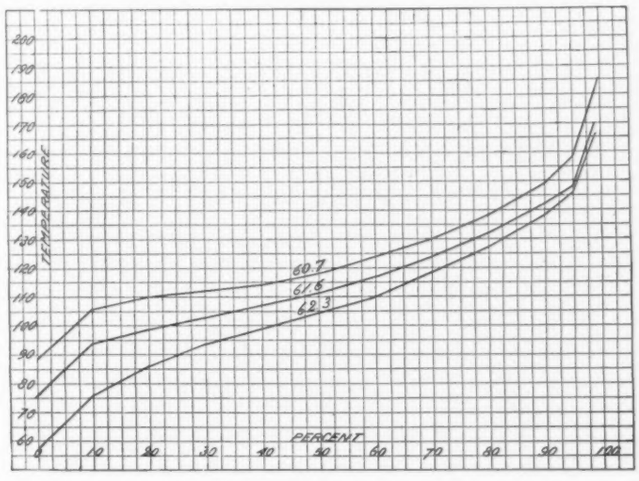


Fig. 2—Curves of Fractional Distillation of Gasolenes Prepared from the Same Crude and by Similar Refining Methods.

products can be satisfactorily assumed as above. As these products are usually purchased by the gallon and heat value specified at so much per pound, it can be easily seen that the most desirable fuel is the heaviest one that can be obtained of the specified boiling points.

Specifications for the purchase of these light distillates should give initial boiling point, that is, the point at which the liquid starts to vaporize, the final boiling point at which all liquid has disappeared from the flask and possibly two or three points in between and the percentages which should boil over at these temperatures. The initial boiling point should be the maximum temperature which will insure easy starting. Final boiling point should be set as high as possible so as to produce a fuel which will not burn too rapidly and yet this must not be so high as to cause carbon deposit. Fuel should, of course, be free from water and other impurities.

When the specifications of distillates are being prepared, it is well to consider the design of the engine and the purpose for which it is to be used. For instance, the ordinary automobile engine usually of high piston speed, working under varying loads, needs a distillate having a narrow range of boiling points, that is, quick burning fuel. Heavy duty engines of slow piston speed and fairly constant loads operate better with fuels having the initial and final boiling points a considerable way apart, as the slow burning fuel develops a higher mean effective pressure. Automobile engines are also subject to another condition. Being required to start easily in cold weather, they must use a fuel having a larger percentage boiling at low temperatures than engines that are installed in buildings kept at a reasonable degree of warmth.

The following specification for liquid fuels will be found very satisfactory for use on gas electric cars. As a matter of fact, a considerable number of cars are operating with fuels having dry points in excess of those here specified. Fuel shall be free from impurities. The initial boiling point shall not be in excess of 185 deg. F. Dry point shall not be in excess of 356 deg. F. (Dry point will be indicated by a small puff of white vapor from residue in flask.) The fractional distillation proceeding at the rate of one drop per second should be recorded in 10 per cent. cuts. The first 10 per cent. should distill at a temperature not

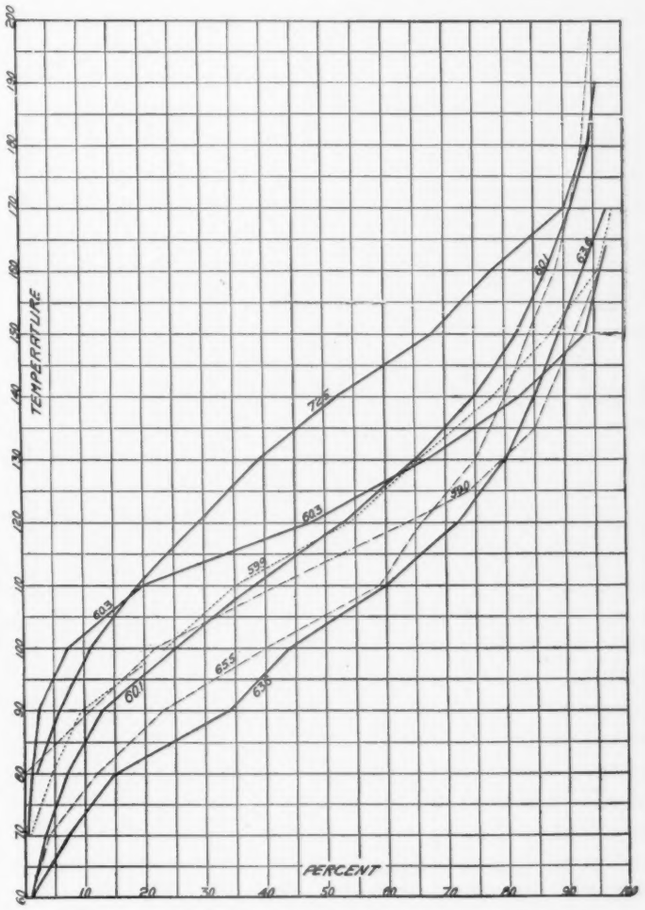


Fig. 3—Curves of Fractional Distillation for Miscellaneous Gasolenes.

in excess of 230 deg. F. Fifty per cent. should distill at a temperature not exceeding 270 deg. F. Not less than 97½ per cent. of the liquid should be recovered from the distillation.

Possibilities of Other Liquid Fuels—At present there is a widespread demand for a cheaper and more efficient fuel than gasolene and naphtha. The demand seems to have been met by a type of internal combustion engine utilizing heavy oils, generally known as the Diesel or high-compression oil engine. Much has been claimed for this apparatus, and the claims have been well substantiated in stationary and marine service, but as yet no engine of this type has been developed that is available for motor car service.

Generally speaking, alcohol, either wood, grain or denatured, is a fuel better even than gasolene, and undoubtedly will figure more prominently in the future than it has in the past. Its advantages lies in the fact that it can be obtained from any veg-

etable matter and is, therefore, available in nearly all parts of the earth. The apparatus required is simple, inexpensive and the cost of production small. Chemically, alcohol is a much more simple substance than gasolene and will be found more uniform. The one bar to its use is a legal one. The government requirements as to inspection, bonding and storing are such as to increase the price unduly. Once these restrictions are removed, alcohol should be a popular fuel. It is true that alcohol has a lesser heat value than gasolene, 14,000 B. t. u., as compered with gasolene at about 20,000, and, therefore, somewhat larger quantities will be needed for the same amount of work, but alcohol should be profitably sold for 4 or 5 cents a gallon if the legal restrictions were out of the way.

In Europe there is a gasolene substitute called benzol which is meeting with considerable success. This fuel is produced by the destructive distillation of coal. The price of benzol is against its use, however, for unless gasolene be over 25 cents a gallon, the cost of production of benzol from coal at $1.75 a ton, even with the revenue derived from the other products of distillation, will prohibit its use.

Thus far no specifications or laboratory tests of oil have been found that are satisfactory for general use. The practical work-out test is by far the best means of determining the merits of a lubricating oil. When purchasing an oil its first cost should not be given undue importance.

Inspection and Maintenance—In order to get the best results out of any motor car it is essential that a definite scheme of inspection and maintenance be laid out. The practice of inter-urban electric roads is probably the best to follow. According to their practice, the motor cars should have a regular inspection at stated periods. This should be a combination of mileage and time. For any car, regardless of mileage, a thorough inspection should be made at least every ten days, and where long mileage is made at least every 2,000 miles. Where practical, it is desirable to have such inspection once a week. This inspection should be rigorous and requires a fairly skilled man to make it. The importance of thorough inspection of motor cars cannot be over-estimated. The man who will successfully take care of axle car lighting equipment is also well fitted to take care of the equipment on motor cars. One of the most effective ways of making inspections is to provide a list of questions for the inspector to answer.

The critical feature in caring for gasolene motor cars is the preventing of the radiators from freezing and the heating of the car. Where cold weather is encountered, a heated shelter is highly desirable.

The accompanying table shows the fuel and lubricating oil performance of a gas-electric car on the Frisco lines.

Motor car mileage	483,529
Passenger car miles	683,372
Average number cars per train	1.413
Naphtha.	
Gallons consumed	334,107
Cost (excluding handling)	$22,823.51
Miles run per gallon	1.447
Cost per mile run	.0472
Car miles per gallon	2.045
Cost per car mile	.0334
Average price per gallon	.0683
Lubrication (Gas Engine).	
Gallons consumed	9,227
Cost (excluding handling)	$2,779.07
Miles run per gallon	52.40
Cost per mile run	.0057
Car miles per gallon	74.06
Cost per car mile	.0041
Average price per gallon	.3011

DISCUSSION.

The operation of both the gas-electric and storage battery cars seems to be satisfactory at all points where they have been in service for any length of time. The men need considerable education before becoming good operators but not nearly as much as it takes to become an engineer of the steam locomotive. The subject of fuel was discussed at some length and it appears that kerosene and lower grade distillates of petroleum are being used with success on some cars. A specification for fuel was advocated.

LOCATION OF STEAM HEAT TRAPS

In a paper on this subject, presented at the annual meeting of the Air Brake Association, C. W. Martin (Pennsylvania) included a number of illustrations showing the various locations of steam traps, and said, in part: The relation of the steam heat trap to the proper performance of the air brake equipment does not seem to be a close one, but to the air brake inspector in charge of equipment, who is called on to give an explanation of the cause of removal of wheels from passenger equipment cars which have been slid flat, the disposition of the water of condensation from the steam heat trap or drip becomes a serious problem. On postal and Pullman cars the number of steam traps has been increased from one or two with the wooden car, to six or seven with the later type of steel equipment, and these are located close to the truck, where the condensation drops on the rail directly in front of the wheel, or is blown back on the truck and brake rigging to freeze and add to the rigidity of the parts, preventing that portion of the truck which should be free to move in order to maintain an equal distribution of the weight of the car on the rail from adjusting itself to the inequalities of the track. This relieves some of the wheels of their proper proportion of the weight at the time the brake is applied, and permits them to slide.

While the introduction of the steel passenger car, with its heavy center girder, has made the proper location of the steam trap more difficult, it is still possible to place it at some point farther from the truck so that the condensation will not be carried back and freeze on the brake rigging, springs and pedestals, and far enough from the triple valve or control valve to avoid freezing up the ports. Where the traps cannot be located away from the truck or triple valve, some arrangement should be made to conduct the condensation close enough to the track to prevent its flying back under the car.

A sheet iron tube clamped to a trap of the vertical type may be used to conduct the water from the trap down close to the track and where the trap is located near the center of the car, gives very good satisfaction.

A guard placed around the trap on the side nearest the part to be protected, and fastened to the trap by a clamp held in place by a stove bolt or machine screw also gives satisfaction. The shield may be made from heavy sheet iron stiffened by a rib of half-round iron along the edge, or by flanging it over a heavy wire. While the objct of this shield is to protect the truck from water and still allow the atmosphere free access to the trap, in order that any variation in temperature may affect it promptly, it has been criticized somewhat because of the water blowing around the edges of the guard because of its being wide and shallow.

Another device is made from a rubber hose, 4 in. in diameter, clamped to the trap and run as close to the track as desired. Where it is necessary to locate the traps outside the rail, this arrangement is preferable to either of those spoken of above. This is especially true when the cars are to be run in an electrified zone, where the third rail is used, as the hose is very flexible, not easily injured by striking an obstruction, and is a non-conductor. This matter is one which should be taken up by the car designers and builders, with a view to having these traps located at some point as far from the track as possible, and where this is not possible, to provide a suitable shield or guard to protect the brake rigging and equipment.

DISCUSSION.

Different members stated that they had experienced considerable trouble from slid flat wheels, caused by water from the

steam traps. It was also stated that the ice found on the trucks and brake rigging in winter would render the brakes inoperative. Mr. Martin said in reference to the use of the 4 in. hose that it was rather expensive and interfered with the changing of the trap diaphragm, but as this was only done every two years it was of no consequence. It is believed that the inconvenience and expense is well compensated for by the service rendered.

AIR HOSE FAILURES

A paper on this subject was read by T. W. Dow of the Erie at the annual convention of the Air Brake Association in Chicago. An abstract follows:

Several roads are making an accurate check of the cost of damage due to burst hose, intending to bring it before the M. C. B. Association to use as an argument for establishing a positive time limit in which to remove all hose from service. While the cost of such a practice might seem unwarranted and excessive to many, when it is compared with the cost of damage to equipment from the failure of the air hose it will be found that there will be a balance in favor of this practice. In checking several thousand 1⅜ in. air hose that had failed because of bursting during the year 1912, the average life was found to be less than 20 months, and a small percentage of the number had been manufactured over 24 months; and it has been suggested by a number of mechanical officials that under the existing conditions it did not appear to be unreasonable to limit the service of air hose to the latter figure, or 24 months.

In making the stretching test on 1 in. sections of various inner tubes it was found that some developed noticeably large holes which at first were very small. These were due to particles of grit which were seen in the rubber before being stretched. It is believed that such conditions account for the large number of porous hose. It is maintained by many, however, that the practice of pulling hose apart is responsible for short life, and it is possible that the pulling apart has a tendency to open up the pores in the inner tubes similar to the conditions developed in the stretching test.

During the soap suds test of the air hose on a large number of trains during the warm season of 1912, it was found that about 10 per cent. were porous. A large portion of this number were porous throughout the entire length of the tube, but many were noticed leaking only at the nipple end, having been injured probably by being bruised, and it is thought that this may be aggravated by the new recommended location of the angle cock, 11 in. back of the pulling face of the knuckle.

While a large number of air hose fail, due to the tube blowing off the fittings, a check during the year 1912 showed a lesser number than during the year 1911. This may have been due to a local condition rather than to any improvement in the make-up of the inner tube, or to the method of fastening, but it is thought that serious consideration should be given to both.

Failure through chafing, being burned, torn off and damaged couplings still continues, but all such can be eliminated by proper attention to the location of the pipes and a regard for a rule that has been many years in print, but not in force, whereby all hose should be uncoupled and not pulled apart. From examinations made, it would appear that air hose manufactured within the two years just passed fail more rapidly than those manufactured four or five years ago.

DISCUSSION.

C. W. Martin (Pennsylvania) stated that tests seemed to indicate that inner tubes with a greater tensile strength were required.

H. F. Wood (B. & M.) presented a report on the life of various grades of hose, which seemed to indicate that the service could consistently be limited to two years.

T. E. Hessenbruch (P. & R.) stated that out of 1,200 pieces of defective hose taken from the scrap pile and given a pressure test of 125 lbs., 54 per cent. were porous, having been in service on an average of 18 months; 24 per cent. failed on the nipple end and 11 per cent. on the coupler end; 3 per cent. were weather beaten, being in service on an average of 48 months; 1 per cent. were cut by the trap; 1 per cent. were torn, and 6 per cent. had miscellaneous failures. Considerable trouble was experienced from rust collecting in the groove of the coupling which prevented the gasket from having a good bearing.

Many members spoke of difficulty experienced in the cold climates with frozen hose. Under such conditions it was found impossible to keep the hose connected, and the gaskets would become torn. It was reported that certain manufacturers produce a hose that will remain flexible in cold weather. Another member stated that a better grade of hose than is commonly used, together with 4-ply canvas, would give good results. The wide face hose gasket has also given very good satisfaction. C. W. Wheeler (N. Y. C. & H. R.) has found it necessary to wire hose together in extreme low temperature.

C. N. Remfry (D. M. & N.) stated that his road made a practice of limiting the life of air hose to two years—although the average life was two years and two months—and claimed a material saving had been made when considering the damage that is done to the equipment by hose failures. He also found that the hose gave better service when the distance between the coupler knuckle and angle cock key was 11 in.

It seemed to be the consensus of opinion that all air hose should be removed from service after it had been used for a certain definite time. The subject was continued for further consideration next year.

CAR WHEEL FAILURES

In a letter to the editor of the *Railway Age Gazette*, published in the issue of May 9, 1913, George W. Lyndon, secretary of the Association of Manufacturers of Chilled Car Wheels, takes exception to the following statement in the *Iron Age* of March 6, 1913:

> The necessity of bringing the quality of the chilled iron car wheel to a proper basis is emphasized today as it has never been, and the makers and users should get together and try and find means of improving the quality of car wheels to make them equal to present service conditions.

The following are extracts from Mr. Lyndon's letter:

Apparently the writer of the article does not know that the Association of Manufacturers of Chilled Iron Car Wheels, representing 95 per cent. of the wheels manufactured in the United States, and the Master Car Builders' standing committee on car wheels have been closely associated since the year 1909 for the express purpose of improving the quality of the chilled iron wheel.

Previous to the year 1909, individual wheel makers had made improvement in their patterns and product, but no concerted action had been taken until the year 1909, when standard wheels for the three classes of cars of 30, 40 and 50-tons capacity were submitted by the manufacturers and approved by the Master Car Builders' Association. Before these three standards were adopted there were as many different patterns as there were manufacturers, and many railroads had standard patterns of their own. The standards recommended were not in general use until the year 1911, because the Master Car Builders' Association gave the manufacturers a sufficient time to adjust their equipment to the new standards.

In analyzing the derailments caused by broken flanges and burst wheels for the purpose of determining what progress has been made in the quality of the chilled iron wheel, we must consider the dates that the wheels were cast, and not charge all the failures during the year 1912 against the product of that year. This is the only proper basis upon which to proceed.

In determining the percentages of derailments of cars due to broken flanges and broken wheels, the number of failures in any one period cannot be consistently compared with another unless

the number of wheels in service is considered, and it is manifestly unfair to state that during the period of 1902-3-4 there were 1,070 derailments, and during the period of 1910-11-12 there were 1,827, and figure an increase of 70 per cent., as was done by the above mentioned writer. In 1902 there were 1,500,000 freight cars in service, representing 12,000,000 wheels; in 1910 there were 2,133,000 freight cars in service, representing 17,068,248 wheels—an increase of 40 per cent. in the number of wheels in service; and this increase represents wheels serving under heavy capacity cars.

The Chilled Iron Car Wheel Manufacturers, in conjunction with the Master Car Builders' Association, have made greater progress in the chilled iron wheel industry since the year 1909 than has ever before been made, and when consideration is given to the vast increases in car capacity, and the resultant increases in rail and axle during the last decade, and the slight increase in the weight of the wheel, it will be found that the chilled iron wheel has not only met every condition of service imposed for the past 52 years, but the record will show that the derailments due to broken flanges and burst wheels are actually decreasing. The following table shows the changes that have been made in developing the 10-ton car to the 50-ton car:

Weight, increase in car capacity	400 per cent.
Weight, increase in rail	100 per cent.
Weight, increase in axle	149 per cent.
Weight, increase in chilled iron wheel	38 per cent.

One part of the chilled iron wheel that has not received due consideration is the flange. In an editorial in *Harper's Weekly* (Industrial series), December 28, 1912, appears the following: "It is a curious fact that in this matter of flanges the cars of today are no better off than were the cars that carried soldiers and supplies to the battlefields of the Civil War."

This condition is not because the wheel makers have not been fully alive to the situation, but because they have been restricted in improvements due to the supposed limits of track clearance. Reviewing the improvements in the flange made since 1904 indicates a slight increase of metal in the back of the flange in 1904, as the weight of the wheel increased from 630 lbs. to 700 lbs.; also that during 1909 a further increase was made, starting at a point slightly below the base line and extending around the flange and back of the tread, producing an increase in tread thickness and increasing the weight to 725 lbs. These slight changes, together with a reduction in the height from 1⅛ in. to 1 in., are the only improvements made in the flange, and it must be remembered that the capacity of the cars has increased from 10 tons to 50 tons. This was all we could get, but not as much of an increase as we wished to make in order to increase the factor of safety.

We are still trying to improve the flange, but cannot go further until such a time as the railroads will approve the design for a flange for 140,000 lbs. capacity cars. When this is done flange failures will be reduced to a minimum.

Many times in looking for the cause of a derailment a wheel will be found with a broken or chipped flange, and this cause is readily assigned, whereas, as a matter of fact, the flange may have been chipped or broken after it left the track, or through poor track, faulty truck construction, etc. We know of cases where a broken flange was reported as the cause of a derailment, and upon investigation we have found that the flange had been worn beyond the condemning limit. Many derailments are reported to the Interstate Commerce Commission caused by sharp flanges climbing the rail in going around curves, or passing crossings, frogs, or switches.

Year Cast.	Broken Flanges.	Year Cast.	Broken Flanges.
1898	2	1908	12
1899	9	1909	13
1900	4	1910	16
1901	7	1911	2
1902	12	1912	2
1903	10		170
1904	8	No record of year cast	457
1905	16		
1906	23	Total reported	627
1907	34		

Let us examine the above record of broken flanges for the year 1912, as compiled from the Interstate Commerce reports.

As will be seen, we have a record of 170 wheels out of a total of 627 reported broken, or 27 per cent. The service is from one to twenty-four years, and the average life of all the 170 wheels is over six years.

As a flange is at its best when first put into service, it will be interesting to note the comparatively few failures for wheels cast during the years 1910-11-12. The total breakages of flanges in the three years amounted to 20 wheels. The report shows that during the year 1910 there were 16 breakages, only two in 1911 and two in 1912. As we only have a record of 27 per cent. of the broken flanges during this period, and as this record shows 16 wheels were cast in 1910, it would be reasonably fair to assume that the balance of the wheels (if tabulation could be made) would bear relatively the same proportion of breakages—therefore, we can assume that if we had a complete record, there would have been broken approximately 60 wheels cast in 1910. During the year 1910 there were in service over 2,000,000 freight cars, and there were running over 16,000,000 chilled iron wheels. This would represent one wheel broken for every 266,000 wheels in service. If we take the total breakages, which are reported as 627, and consider the number of wheels running, we will find that there is one breakage for every 25,000 wheels in service and the broken flange wheels which we have tabulated from the Interstate Commerce Commission reports show an average of six-and-a-half years' service. Surely this is not an alarming condition when we take into consideration that a very large percentage of those broken were of the old design and plainly show abuse due to sticking brakes and excessive wear.

We will now analyze the report of broken wheels. Our record, as compiled from the Interstate Commerce Commission report, shows the detail of 109 broken wheels as to years cast, name of maker, etc. There were 229 breakages for which we could obtain no record. An analysis of the 109 wheels reported is shown in the following:

Year Cast.	Broken Wheels.	Year Cast.	Broken Wheels.
1889	1	1908	5
1892	1	1909	9
1897	1	1910	14
1899	1	1911	10
1900	5	1912	7
1901	3		109
1902	8		
1903	9	Broken and loose tires on engine drivers	19
1904	4	No record of year cast	229
1905	6		
1906	12	Total	357
1907	13		

It will be observed that the broken wheels, like the broken flanges, are distributed over a period of years, starting with the year 1889, and the average service of all wheels broken is over six years. The cause assigned for the breakage of 52 wheels out of the 109 reported by the Interstate Commerce Commission is "brakes sticking."

Fifty per cent. of the broken wheels were caused by "brakes sticking," and 90 per cent. of the broken wheels occurred in the mountainous regions of the East and West, where the maximum of brake resistance is required in descending grades. A large number of these wheels plainly show improper usage.

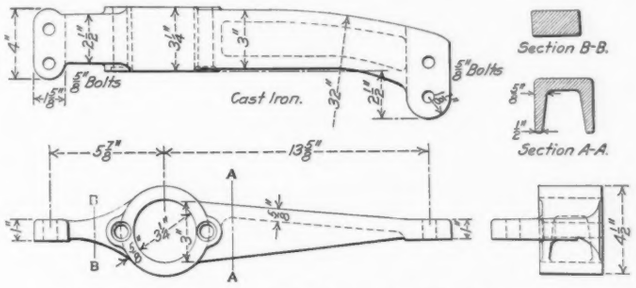
It is no uncommon thing to find 625 lb. wheels under cars weighing from 45,000 lbs. to 50,000 lbs.; in fact, many 60,000 lbs. capacity cars weigh light more than 100,000 lbs. capacity cars. The Master Car Builder's Assn. in its 1912 Proceedings recognized the question of establishing the maximum braking power as well as gross load for each design of wheel, and called particular attention to the trouble experienced in using 625 lb. wheels under 60,000 lbs. capacity cars, having tare weight of 40,000 lbs. to 47,000 lbs., such as refrigerator cars, etc.; if their recommendations are followed broken wheels will be practically eliminated.

If we take the entire number of chilled iron wheels broken during the year 1912 and base these breakages upon the number of wheels in service, we will find there is, comparatively, one broken wheel for every 50,000 wheels in service.

NEW DEVICES

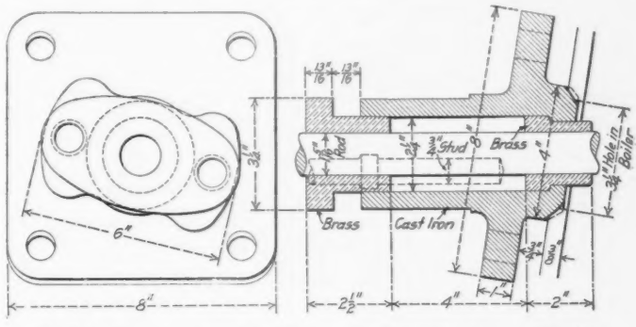
IMPROVED THROTTLE LEVER RIGGING

The American Locomotive Company has designed and applied to a number of locomotives an improved arrangement in connection with the throttle lever and its attachments. This construction provides for the complete assembling of the lever and its connections before the parts are sent to the erecting shop and requires the laying out and drilling of but two holes for applying it to the boiler. It has the further advantage of permitting an adjustment in the height of the throttle lever handle, if desired for more convenient operation, or a change in the position of the lever if it is found that it interferes with the operation of any of the attachments on the back boiler head, which are already in place or may be applied at some later time.

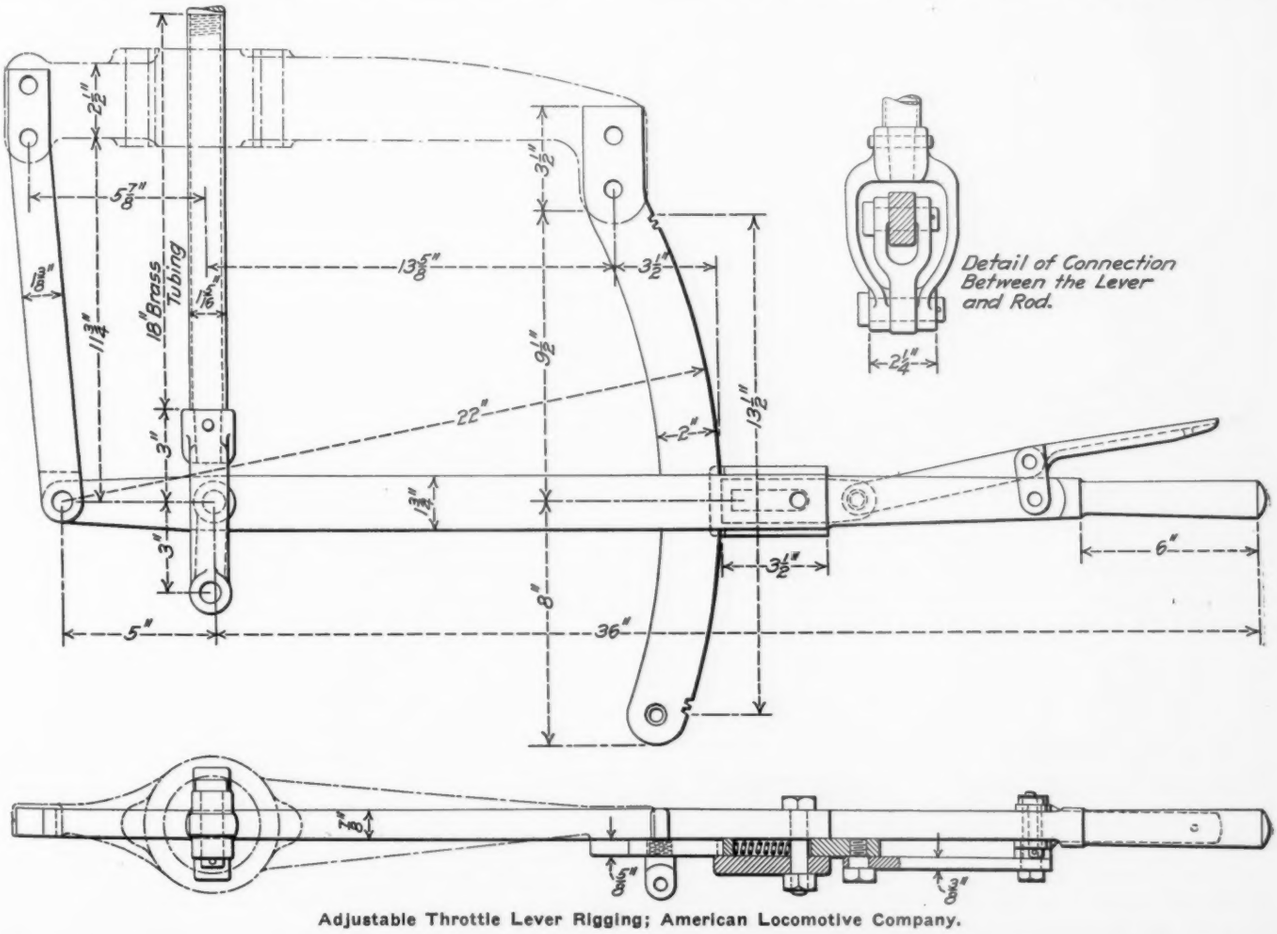


Casting Which Supports the Lever and Its Connections.

In this construction, a somewhat enlarged throttle rod stuffing box is securely fastened to the boiler head by four studs. The circular extension on this is machined on the outside, and over this fits a special casting to which the throttle lever link is connected at one end and the quadrant at the other. The bearing on the stuffing box in the application illustrated, which is the design as applied to Mikado locomotives for the Grand Trunk, has a length of 3¼ in. and a diameter of 3¼ in., giving a rigid support for the whole rigging. There are two studs holding this casting in place and, by using slotted holes, it is possible to change the angle of the lever as desired. An improved yoke connecting



Stuffing Box Arranged to Carry the Throttle Lever Rigging.

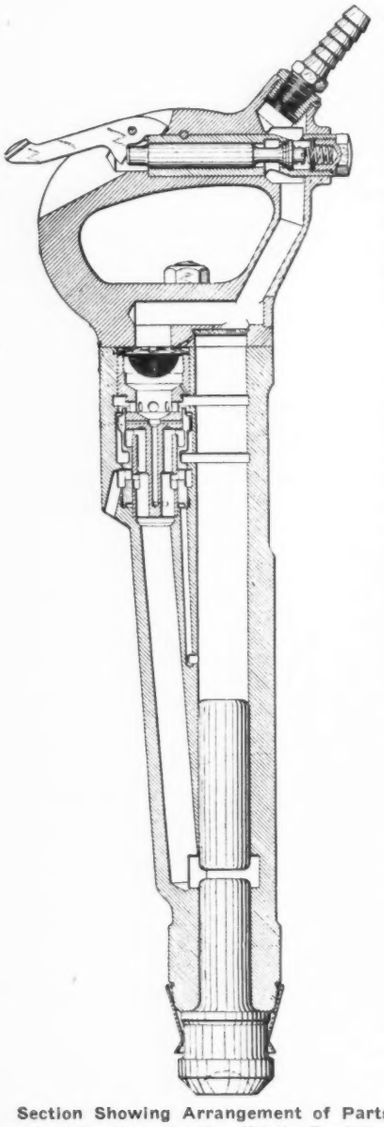


Adjustable Throttle Lever Rigging; American Locomotive Company.

the lever to the rod is used in this case. It is made of malleable iron and is somewhat lighter than previous arrangements. The details of its construction are clearly shown in the illustration. In other particulars the construction does not depart from the previous standard practice of this company.

LITTLE DAVID RIVETING HAMMER

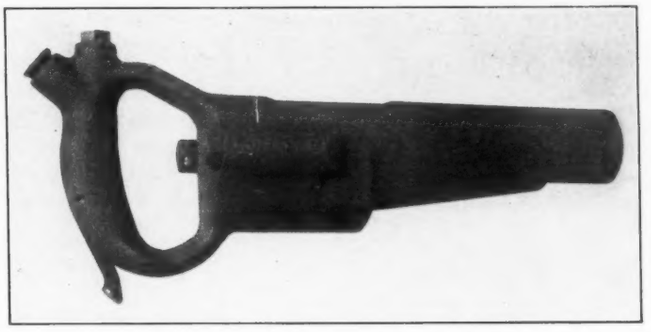
Several novel features have been incorporated in the design of a pneumatic riveting hammer recently perfected by the Ingersoll-Rand Company, New York. In these hammers, which have been given the name "Little David," the valve chamber is located at the side of the cylinder, permitting the use of pistons of different lengths without liability of valve breakage. The cylinder and handle are both drop forged, and are held together by two bolts instead of the usual threaded connection. This permits the ready separation of the two parts for inspection or repairs without the use of a vise or bar. All of the wearing parts are hardened and the outside of the hammer is sand blasted, giving a rough surface and a better grip. These hammers are both shorter and lighter than previous designs of the same power, and are provided with a very sensitive throttle control which makes them especially suitable for drift pin work. Two sizes are being built, providing a 6 in. and an 8 in. stroke. The former is suitable for work up to ⅞ in. diameter rivets and the latter up to 1¼ in. diameter rivets.



Section Showing Arrangement of Parts and Passages in the "Little David" Air Hammer.

Reference to the drawing will show the arrangement of the interior parts. The exhaust passage is of large volume and liberal area and a single port is used for admission. The action of the valve and piston is controlled by the variation of pressure alternately on different faces of the valve. This is accomplished by the piston opening a small port leading to the bottom of the valve when it is near the end of its stroke, which, in connection with the proper proportioning of the various feed ports in the valve chamber, gives the valve a reciprocating, cushioned movement, admitting air alternately through the top port for the downward stroke and through the large exhaust port for the upward stroke of the piston.

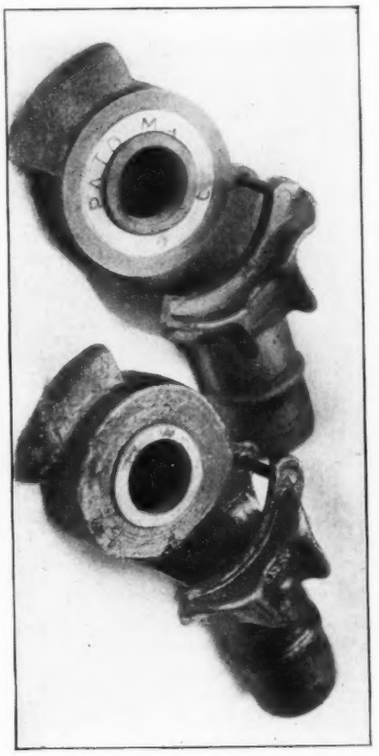
There is a small port admitting live air to the very top of the cylinder which cushions the piston after it passes the admission port. A strainer is provided through which all the air entering the hammer must pass, thus preventing the admission of dirt or other foreign matter to the working parts. This arrangement of ports and passages has greatly reduced the recoil, and the hammer is very well suited for steel car work.



An Improved Air Hammer for Riveting.

AIR HOSE COUPLING

At the recent convention of the Air Brake Association at St. Louis, attention was directed to the trouble experienced from rust collecting in the groove of the air hose coupling, which prevented the gasket from having a good bearing. The Sheafe coupling, which is shown herewith, was designed for overcoming this, as well as other difficulties. This coupling has a brass bushing inserted in its face. The gasket groove is made in this bushing, so that when the gasket is inserted it touches nothing but brass, and is therefore not affected by any rust. The coupling has a smoother seat than is possible with malleable iron and it will remain smooth for many years. It is claimed to save 50 per cent. of the gaskets and to give much more efficient service. Leakage at the coupling is a large factor in air brake operation; it not only interferes with the correct manipulation of brakes, but increases the service required of the compressor. These couplings have been in service since 1909, and are now standard on two railroads. They are manufactured by the Central Engineering Company, with headquarters at Chicago and are sold by Guilford S. Wood, also of Chicago.



Sheafe Air Hose Coupling Compared with One of the Standard Iron Couplings.

Cost of Full Crew Laws.—The Erie estimates that the full crew laws will cost it $447.180 yearly. The Erie works under such laws in New Jersey, Pennsylvania, Ohio and Indiana, and there will be one in New York after September 1.

SAFETY DEVICES FOR LOCOMOTIVE BOILERS

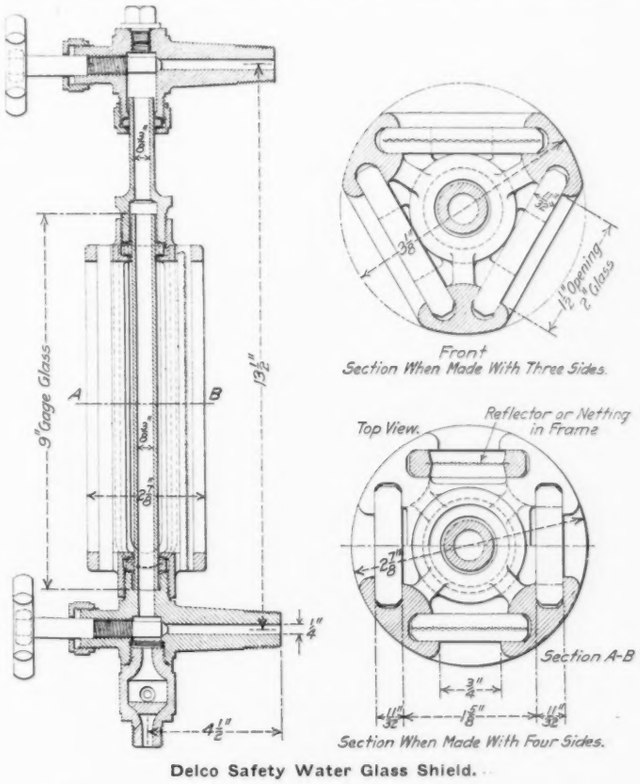
Burst Water Glasses and Defective Squirt Hose Cause Over 48 Per Cent. of the Accidents.

In an editorial on water glass shields in our issue of May, 1913, page 227, we directed attention to the importance of using a type of shield which will prevent injuries to the members of the engine crew from flying glass when the tubular glass breaks and from escaping steam and hot water. An improved water glass shield used on the new Lake Shore Mikados was illustrated on page 235 of the same issue. In the following article two improved shields are described which are reported to have given good results on the Delaware, Lackawanna & Western, and the Pittsburgh & Lake Erie.

A device was also used on the Lake Shore engines which makes it possible to use cold water from the tender tank for wetting down the coal and the engine deck, thus eliminating danger of scalding due to the bursting or forcing off of the connections of the squirt hose. Two devices are described in this article for preventing such accidents, one an armored hose with special connections, and the other an ejector which furnishes water at a comparatively low temperature.

DELCO SAFETY WATER GLASS SHIELD.

The Delco safety water gage shield, which is shown in the illustration, was devised to prevent the flying of broken glass



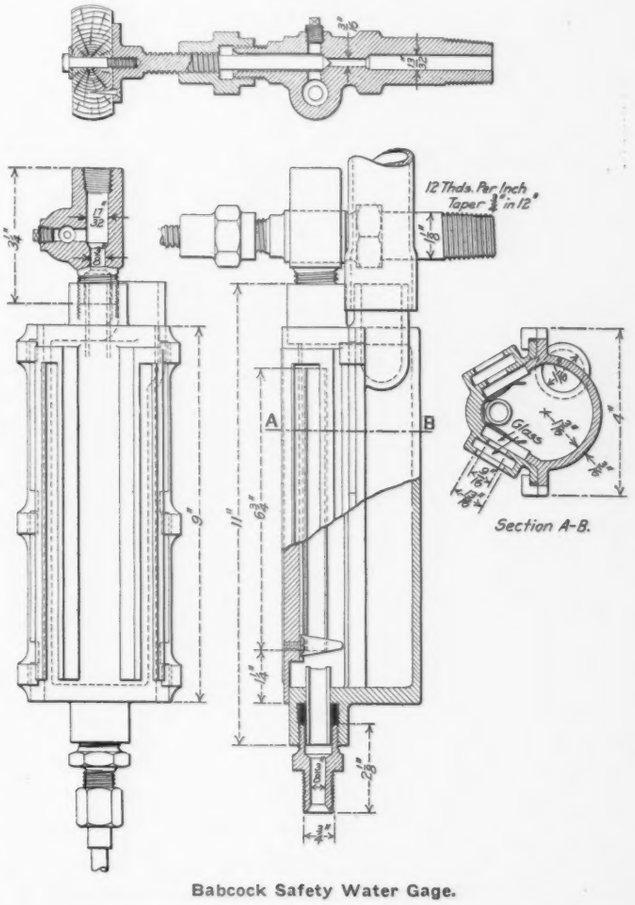
Delco Safety Water Glass Shield.

and boiling water and also the scalding of the hands of persons engaged in turning off the gage cocks after a water glass bursts. It consists of a one-piece body fitted with glands to receive the regular tubular glass, and with slots for the heavy glass protecting plates. The glass shield is omitted at the rear and a perforated plate, or netting, is inserted in its place to permit of the escape of the water and steam when a gage glass bursts; this prevents the steam and water from blowing down and scalding the hands of any one engaged in turning off the gage cocks. The shield is made in a standard length which permits the use of tubular glasses with fused ends, thus overcoming breakages due to rough edges which frequently start progressive fractures. The one-piece construction also permits the water glass to be perfectly alined and overcomes the difficulty of the glass breaking due to a twisting action on account of one of the fittings being out of line. Tubular extensions are provided so that the shield may be assembled complete before application to the boiler, and may be applied between boiler fittings placed any distance apart. As the water glass is contained in the shield itself, it is impossible for any one in renewing a glass to forget the application of the shield. A straight passage is provided entirely through the water glass and boiler fittings so that a wire may be passed through to clean out obstructions, as is required by law.

The Delco shield is the invention of H. C. Manchester, superintendent of motive power and equipment, Delaware, Lackawanna & Western, and over 750 of them are in use on that road. It is manufactured by the American Safety Lamp & Mine Supply Company, Scranton, Pa.

BABCOCK SAFETY WATER GAGE.

In the designing of safety water gages it is most important that the passage provided for the escape of the steam and water after a water glass bursts be amply large, as otherwise pressure

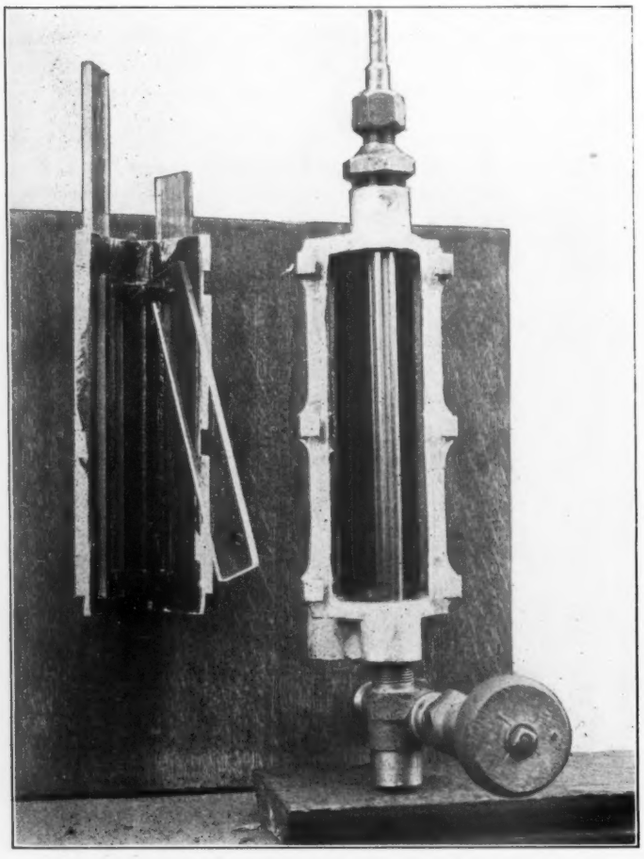


Babcock Safety Water Gage.

will accumulate and cause the breakage of the protective glass in the shield, and the steam will pass directly into the cab. In the gage which has been adopted as standard on the Pittsburgh & Lake Erie a pipe, shown in the illustrations, has been provided to carry off the broken glass, as well as the steam and water

during the interval while the gage cocks are being closed. This safety gage is provided with two sets of heavy glass plates, an outer and an inner, the latter being held in place by steel springs. The purpose of the inner plate is to absorb the shock of the explosion and in case the inner plates should break there is still left the outer set to prevent the escape of the steam and broken glass into the cab. These protecting plates are set at such an angle that both the engineman and the fireman can get a plain view of the inner tubular glass. It is further claimed that the breakage of the inner plates is very unlikely, owing to their location permitting only a glancing blow from particles of broken glass.

The safety gage is the invention of F. H. Babcock, assistant



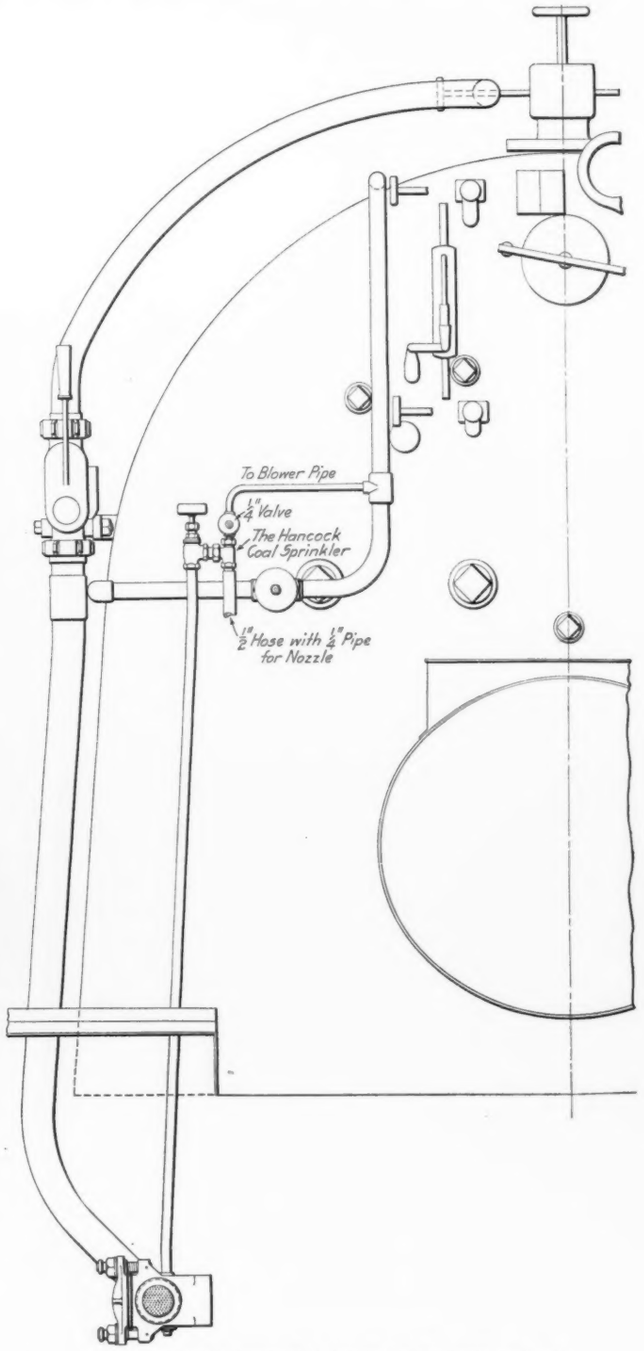
Babcock Safety Water Gage with Glass Removed.

boiler shop foreman, Pittsburgh & Lake Erie, McKees Rocks, Pa., and is manufactured by the American Car & Ship Hardware Manufacturing Company, New Castle, Pa.

EJECTOR FOR COAL SPRINKLING.

It is the general custom in wetting down the coal on locomotives to take the water supply from the delivery pipe of one of the injectors through a squirt hose and the necessary connections. The water in the injector delivery pipe is at a temperature and pressure sufficiently high to cause serious accidents in cases where the hose bursts. The device shown in the two illustrations, for the sprinkling of locomotive coal, is entirely independent of the injector, taking its steam supply from a pipe branching off from the blower pipe. The principle is the same as that of a lifting injector; steam is admitted through a ¼ in. globe valve and raises the water through the suction pipe which is connected to the main delivery pipe from the tender. A ½ in. valve is placed in this suction pipe to prevent waste of water in case the apparatus is located below the highest water level in the tender, and also to prevent air being drawn into the suction of the injector should there be an obstruction in the suction hose. The quantity of steam used is very small, and, although there is an ample supply of water under sufficient pressure to sprinkle the coal, the temperature is so low that no serious accident can occur and there is an absence of the steam which is very commonly seen in the cab of a locomotive when the squirt hose is being used.

This device was developed and is being manufactured by the



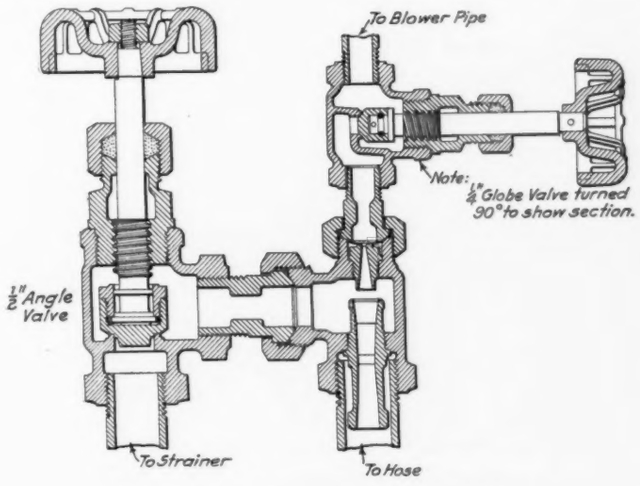
Application of Hancock Ejector for Sprinkling Coal.

Hancock Inspirator Company, Boston, Mass., and is being applied to 150 Baltimore & Ohio locomotives.

ARMORED SQUIRT HOSE.

Accidents due to defective squirt hose and connections are caused by the bursting of the hose or by the hose being forced off its connection, thus allowing the steaming hot water to scald the firemen, and in some instances the enginemen as well.

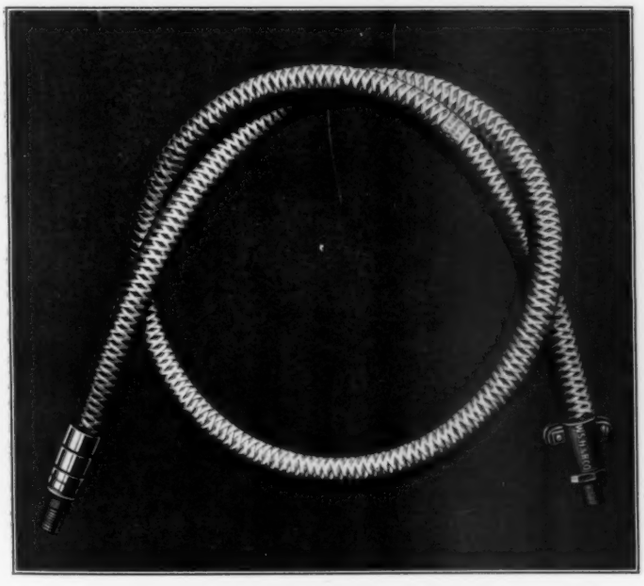
In many cases a cheap grade of garden hose is used, which soon fails under the severe service to which it is subjected and in other cases the hose is very insecurely fastened to its connection. The Woven Steel Hose & Rubber Company, of Trenton, N. J., has for a number of years been manufacturing a flexible armored hose. It was first adapted for use as a squirt hose about three years ago, and is reported to have given good results and to



Section Through Ejector for Coal Sprinkling.

have an exceptionally long life. Five thousand locomotives are said to be equipped with it, on such roads as the Pennsylvania, Baltimore & Ohio, New York, New Haven & Hartford and the Boston & Maine.

The hose is made with a steam tube instead of a water tube, and will therefore last much longer under the action of the hot water. It is covered with a strong flexible covering of steel,



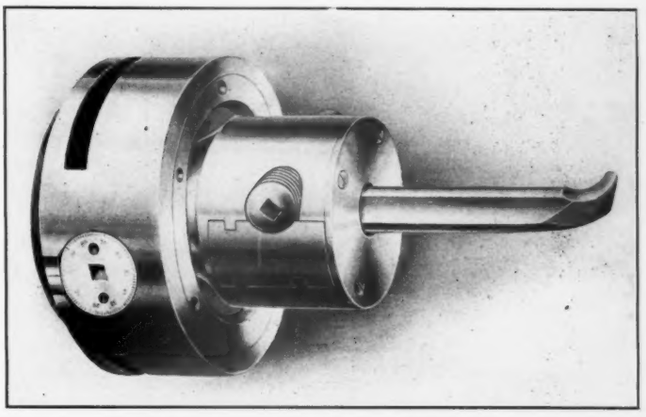
Armored Squirt Hose.

protecting it against exterior wear and the chafing caused by the constant vibration of the locomotive. Special fastenings, which are clearly shown in the illustration, have been devised to prevent it from blowing off the nipple.

Obviously the first cost will be much higher than that of the type of hose ordinarily used for this purpose, but it is said to last so much longer that its cost per unit of time is considerably less.

OFFSET BORING HEAD

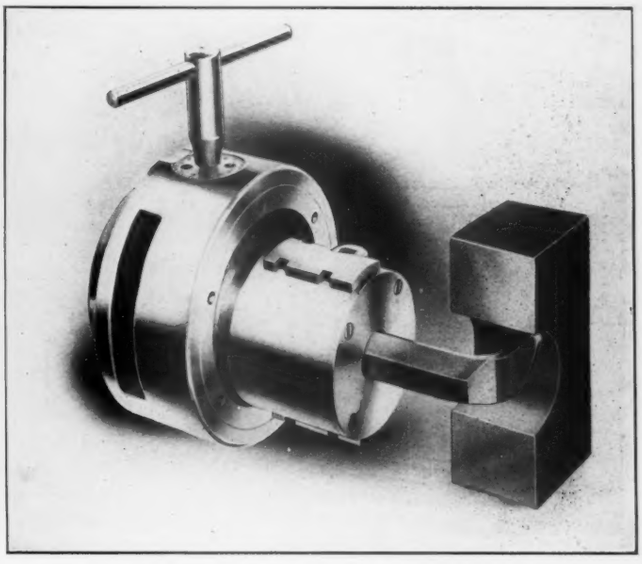
An offset boring head, designed for the accurate boring of holes wherever it is more convenient to revolve the cutter than the work, has been perfected by Marvin and Casler, Canastota, N. Y. It consists of a cylindrical cast iron body which carries across its face a strong steel offsetting plate that is held from turning by a key, and is adjusted in an offset position by a case



Offset Boring Head in Central Position.

hardened screw which is graduated to read to a thousandth of an inch. This plate is threaded to receive a chuck or boring bar, and is adjustably tensioned and held in place by a ring nut. Offsets from 3/16 in. to 5/8 in. are provided and the illustrations show the boring head when central and in its extreme position.

By using a boring tool having an offset cutting edge, a combination of turning the tool in the chuck and the use of the offset in the head, permits the boring of a wide range of diameters with the same tool. While these boring heads are par-



Boring Head Offset to the Limit of Its Movement.

ticularly adapted for use on milling machines, they have also been found suitable for work on a turret lathe, especially for recessing, and also on drill presses for work which may be too heavy or cumbersome for a lathe or milling machine.

DEATH RATE IN COAL MINES.—The death rate per 1,000 men employed in the coal mines of the United States in 1912 was 3.15, as against 3.73 in the previous year.

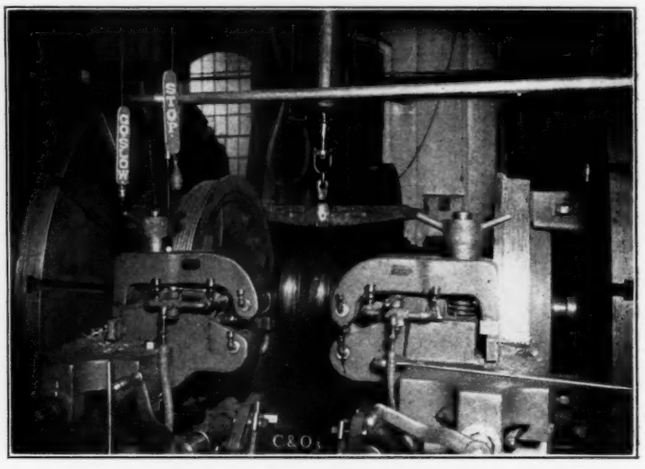
NEW MODEL DRIVING WHEEL LATHE

A set of four 56 in. driving wheels turned in 2 hours and 7 minutes is a record recently made at the Richmond, Va., shops of the Chesapeake & Ohio. This was made possible by using a new lathe which has ample power for making very heavy cuts and is provided with a number of new attachments for increasing the speed of the work when the machine is not cutting. In making this record, the average depth of cut was 5/16 in., the feed was 9/16 in. and the cutting speed varied from 15 ft. to 17 ft. per minute. This means the removal on an average of 33¾ cu. in. of metal a minute which, according to Mr. Pomeroy's chart, published on page 248 of our May issue, would require about a 35 h. p. motor. Inasmuch as the machine is provided with a 50 h. p. motor, which will permit the removal of 50 cu. in. per minute, it is evident that even heavier cuts could be taken and a record as good as this could be made under even more difficult conditions.

An examination of the details of this record, shown in the table herewith, indicates that it was not so much the saving in the cutting time that made it possible, as the reduction in the time required for putting the wheels in and out of the machine and the method employed to reduce waste time in adjusting the tools and calipering the work. A power traverse for the tail-stock, a pneumatic tool clamp and a permanent calipering arrangement are provided. Putting the wheels in the lathe in from 3 min. to 7 min. is made possible largely by the power traverse for the tail-stock. This is arranged with a separate motor and controller, located in a convenient position, and a friction safety device is included to prevent damage in case the face plate is brought up too forcibly against the wheel. The grips on the outside of the tire are then set up and the clamp bolts inserted and tightened. A cam mechanism is provided for clamping the tail-stock, which is operated by a single lever.

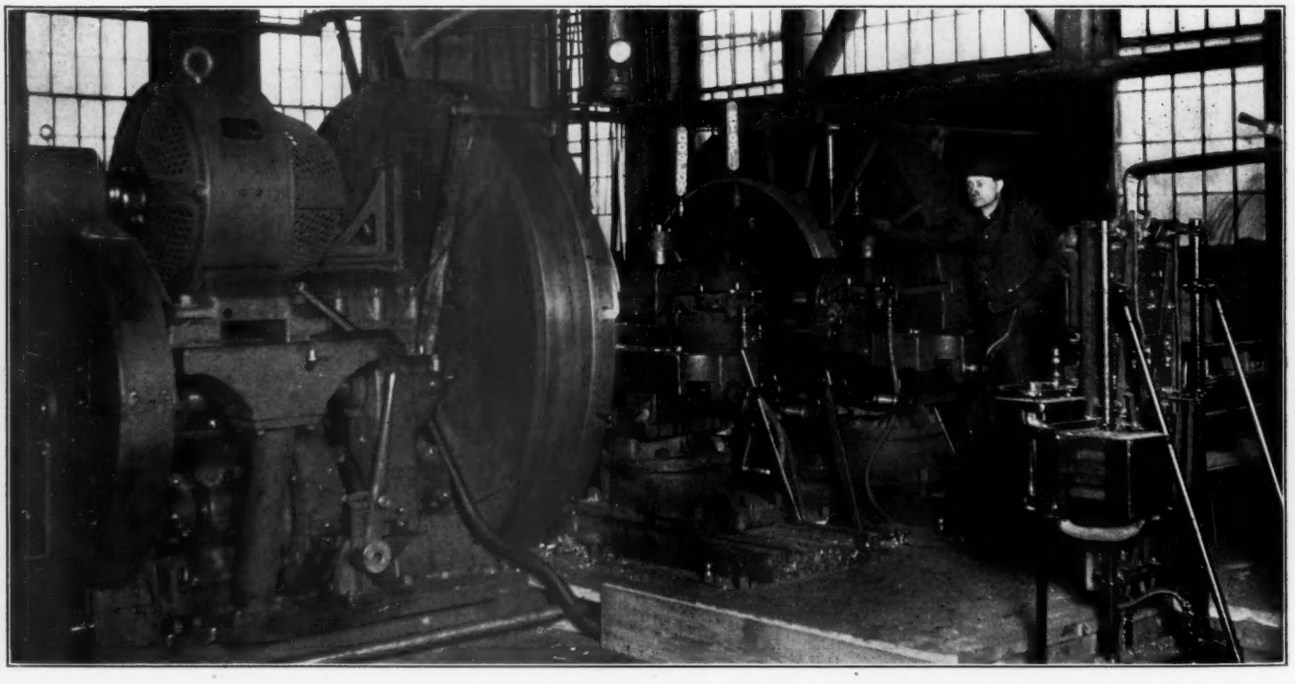
Pair Number.	Time Putting in Lathe. Minutes.	Time Roughing and Finishing. Minutes.	Time Taking Out of Lathe. Minutes.	Time from Floor to Floor. Minutes.
Set from First Engine.				
1	5	30	4	39
2	6	26	4	36
3	7	28	4	39
4	5	26	3	34
Set from Second Engine.				
1	3	21	3	27
2	6	25	3	34
3	5	30	2	37
4	5	21	3	29

In both cases—Diameter of wheels, 56 in. Average depth of cut, 5/16 in. Average feed, 9/16 in. Cutting speed, 15 to 17 ft. per min. Total time for turning complete set, first engine, 2 hours 28 minutes. Total time for turning complete set, second engine, 2 hours 7 minutes.



Pneumatic Tool Clamps and Motor Control Switches on New Driving Wheel Lathe.

In making this record, the following methods were followed: After the worst worn pair of wheels in the set was in place in the lathe, the smallest wheel was selected and the roughing tool was inserted in the tool post and run in to the lowest point of the tread. The tool slide was then marked and the tool drawn back, the rest moved over to the outside of the tire, and the tool run in beyond the mark an amount sufficient to build up the flange. The cut was then started on this wheel and the calipering attachment which is part of the machine was employed to make the other wheel the same size without trial or adjustment of the tool. The roughing cut was then run across the tread, requiring from eight to eleven revolutions.



New Model Wheel Lathe Which Turned a Set of Four 56 in. Wheels in 2 Hrs., 7 Min.

The tool was then withdrawn an amount equal to the height of the new flange. This operation was facilitated by previously determining the number of turns of the crossfeed screw that is required for this standard distance. Two or three revolutions are required for running the roughing tool across the top of the flange. This tool was then removed and the flange roughing tool—the third tool from the left side in the illustration—was inserted and formed the flange in about two revolutions. The combination flange and tread tool shown at the right of the group was next inserted and finished the flange and part of the tread in from two to three revolutions. The chamfering tool, shown as the second from the left in the illustration, was then put in the tool post and finished the tread in from two to three revolutions. Before removing the wheels, the slide was marked when the nose of the roughing tool, which was again clamped in the rest, was against the finished tread. The tool was then run back and after the following set of tires was in place, the marked slide allowed the cut to be immediately started

Tools Used in Making New Record for Turning Driving Wheel Tires.

without further adjustment or trial. Removing the clamps, running back the tail-stock and removing the wheels required from three to four minutes.

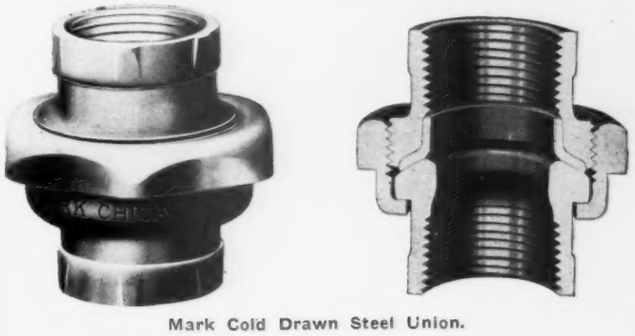
It will be noticed that a flange roughing tool is used in this case although accepted good practice does not require it. This is done because the machine has a pneumatic tool clamp which permits a very prompt changing of tools. It would not be advisible to make this change if a clamp requiring a longer time was used. One of the illustrations shows this style of tool clamp and it will be seen that by the movement of the valve handle on a three-way valve, the wedge between the rollers on the outer end of the clamp is promptly forced out or drawn in by the air cylinder, located in the center. A coiled spring under the adjusting screw raises the clamp and releases the tool as the wedge is withdrawn.

Another new feature of this machine which has aided in breaking previous records for time, is the magnetic push button control that is provided when a direct current motor is used to drive the lathe. Two push button switches are suspended near the cutting tools, one for starting and stopping the motor, and the other for slowing down the speed. This gives the operator control from a convenient position and he can readily slow down the machine when hard spots are encountered or stop it at the moment the cut is completed without moving from his post.

This new lathe is made considerably heavier and more powerful than previous designs and in a number of shops throughout the country, records practically equal to those quoted are being made. The machine is built by the Niles-Bement-Pond Company, New York.

MARK COLD DRAWN STEEL UNION

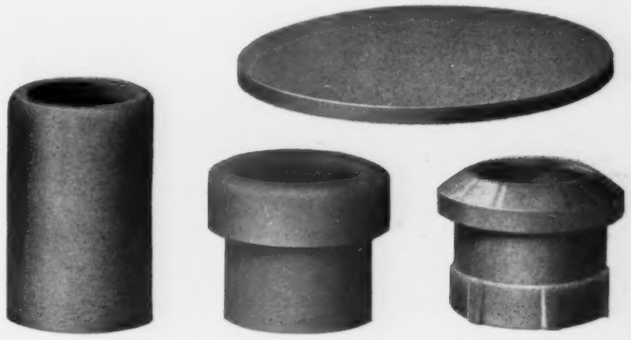
The Mark Manufacturing Company, Chicago, has placed on the market a pipe union made entirely of cold drawn steel. These unions are made from flat strip steel which provides a fitting that is seamless, free from sand holes, pin holes or other similar structural defects. The process of manufacture of the male member of the union is shown in one of the illustrations. Discs are cut from flat strips of steel and drawn to deep cups



Mark Cold Drawn Steel Union.

from which the bottoms are punched. One end of the tube is then folded or rolled back on itself to form a reinforcement and later pressed to its final shape, making a dense, hard steel seat. The lower end is then upset. The brass seat ring is also drawn cold from flat soft stock and annealed after drawing to keep it soft. Both the steel seat and brass ring are formed in dies and do not require machining or grinding.

The union is threaded to the Briggs standard pipe thread



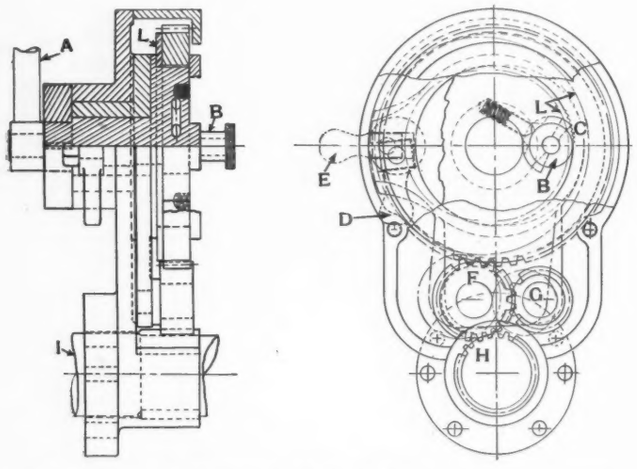
Various Steps in the Manufacture of Mark Cold Drawn Steel Unions.

and carries the same taper as the pipe. Each union is put through the Sherardizing process after the threads are cut so as to protect all surfaces from corrosion. An important feature of this union is that it has the same coefficient of expansion as the wrought-steel pipe to which it is applied and will, therefore, be less liable to leakage and will require less attention than unions made of different material. The Mark union has shown up remarkably well under tests.

LAST BROAD GAGE LOCOMOTIVE IN ENGLAND.—With the changing to standard gage of the broad gage railway, 1¼ miles long, at Holyhead, England, the last locomotive with a 7 ft. gage will be taken out of service.

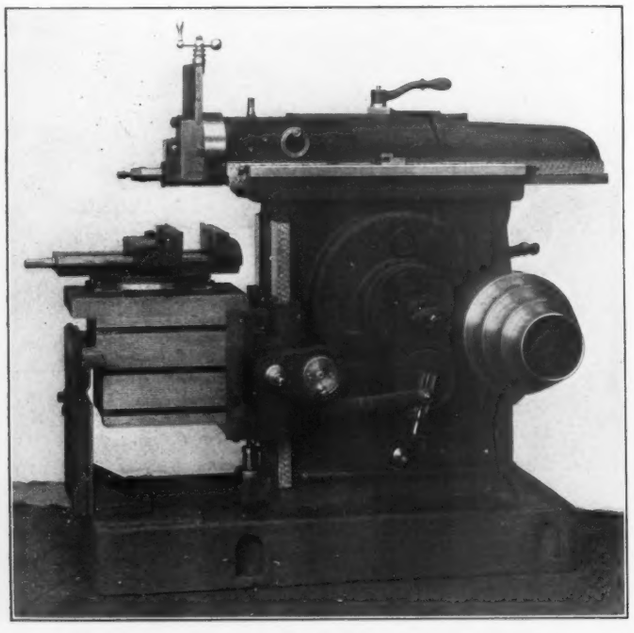
HEAVY DUTY BACK GEARED SHAPER

A shaper designed to meet the heaviest requirements and embodying a number of new features is shown in the illustration. In order to protect the machine against any possibility of breakage, a new cross feed has been developed which makes it impossible to feed against the cut. A reciprocating motion is imparted to *A* through the usual type of cross feed rod and the click *B* is, in turn, moved over the internal ratchet gear *C*, giving it an



Arrangement of the Cross Feed on the New Stockbridge Shaper.

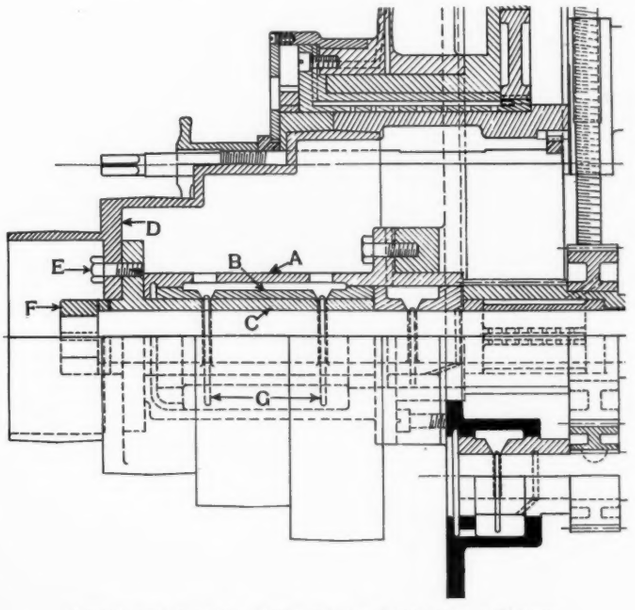
intermittent motion which is determined by the amount of feed. The motion of *C* is communicated to the cross feed screw *H*, either directly through the intermediate gear *F* or through the two intermediate gears *F* and *G*; by this means the direction of feed is changed. In order to secure these two positions in the



Heavy Duty Shaper; Stockbridge Machine Company.

train, the two intermediate gears are supported on a rocker which may be thrown to any one of three positions; one with the handle at *D*, when the feed is direct through the gear *F;* another by moving the handle through an arc of 180 deg. and feeding through the two intermediate gears *F* and *G;* the third with the handle in the 90 deg. position *E*, when the gears are neutral and the yoke *L* has been raised sufficiently to automatically throw the click *B* out of engagement with the gear *C*. In this way, it is claimed, all possibility of the gears becoming caught when changing the direction of feed is eliminated and the saving of time will be appreciated by everyone who has had occasion to use a shaper on work where it was desired to feed across in one direction and then back without having each time to change the cross feed rod or the direction of feed by adjusting the screw. Another advantage claimed for this motion is that it is impossible for the operator to feed on the cut and there is thus no danger of cross feed parts being broken.

The base of the machine is heavily designed to absorb vibration and provide sufficient strength to support the weight without springing. It is slightly concaved on the outside and has a pan cast on the inside to protect the floor from becoming oil soaked, the oil being drained to a pocket from which it can be drawn off. The driving cone is supported on an independent bearing built out from the shaper column. The belt pull is carried entirely by this bearing, the driving shaft being driven by a two-jaw clutch *F* shown in another of the illustrations, and carried by an independent bearing. The cone bearing which is bolted to the column of the machine is shown at *A; B* is the bushing and *C* is the cone



Clutch and Driving Shaft of the Stockbridge Shaper.

hub. The cone is indicated by *D* and is bolted to the cone hub by means of four bolts *E*. The oil rings *G* keep the bearing flooded with oil and all shaft bearings are bushed and self-oiling.

The shaper is equipped with the Stockbridge patented two-piece crank motion giving a 3 to 1 quick return; the crank is provided with a double bearing which eliminates all overhang and maintains alinement. A telescopic screw with ball thrust bearings is provided for raising and lowering the table; the top of the knee is made separate and hooks over the saddle. The ram can be adjusted to any length of stroke and taper packings, adjusted from either end by means of screws, are provided to take up wear. The table support automatically adjusts itself to any height and gives a bearing the entire width of the table.

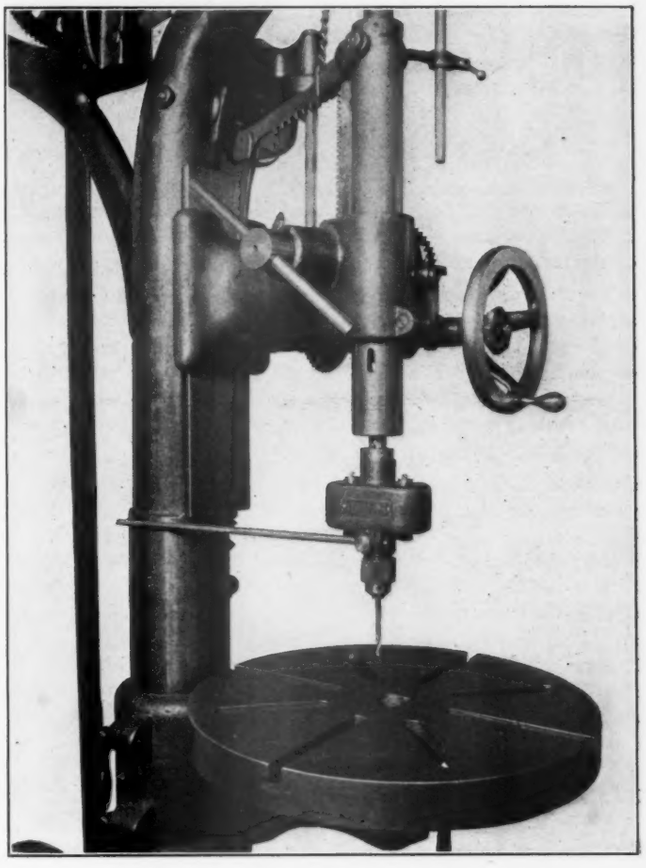
This shaper has been developed by the Stockbridge Machine Company, Worcester, Mass. The following are some of the principal dimensions:

Length of stroke	20¾ in.
Vertical range of table	13 in.
Cross range of table	26 in.
Greatest distance, ram to table	15½ in.
Diameter of head	8⅝ in.
Feed of head	9 in.
Top of table	14 in. x 20 in.
Side of table	14 in. x 15 in.
Vise opens	13½ in.
Vise jaws	13½ in. x 3 in.

Number of steps on cone	4
Number of speeds to ram, cone drive	8
Number of speeds to ram, gear box drive	10
R. p. m. of countershaft	350
Total ratio of gearing, back gears	26.4:1
Total ratio of gearing, direct drive	6.6:1
Ratio of cutting and reverse strokes	3:1
Weight of machine and countershaft	3,750 lbs.

DRILL SPEEDER

It is sometimes desirable to be able to drill holes less than 5/8 in. in diameter while the work is on a large radial or other type of comparatively slow operating drilling machine. These large size machines are seldom provided with the speeds necessary for small size drills. An attachment which makes it possible to use the smallest size drill on any size drilling machine has been designed by the Graham Manufacturing Company, Providence, R. I., and is shown in the illustration. It consists of a nest of gears, enclosed in a small case, which triple the speed of the spindle. It is arranged to fit the standard size shanks of ordinary drill presses and to allow the insertion of very small drills at the bottom, either by a chuck or taper socket. As will be seen, the small drill is on the same center line as the spindle of the machine and the arrangement is such that no end thrust is conveyed through the speeder. The gears and pinions within the case are arranged in pairs and side strains are entirely eliminated. The lower end of the shank, extending downward inside the hollow spindle, reaches nearly to the bottom of the case, insuring a correct alinement. A bar fastened to the case by a thumb screw prevents the attachment from turning. This is long enough to reach to the column in the case of a large upright drill, but when used on a radial drill some rigid stop must be provided, or the bar can be held by the hand, if desired. In the drill speeder shown the feeding of the drill is done by the mechanism on the machine. Other styles, however, have sensitive feed levers that permit the feeding through a racked sleeve within the speeder itself.

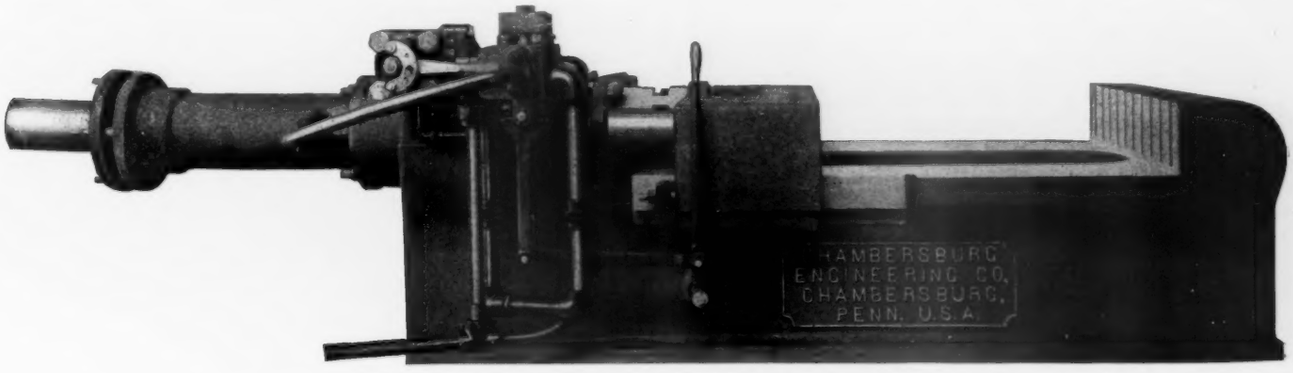


Application of Drill Speeder to Upright Drill.

HYDRAULIC FORGING AND BENDING PRESS

The illustration shows a hydraulic forging and bending press for locomotive and car shop work, such as the making of equalizer bars and other heavy bending and straightening, which is commonly done in a geared type of bulldozer. This machine will handle a wide range of work, and the application of the power is direct and positive. A further advantage claimed for it is that of being safe from breakage, due to the operator putting in work which has become too cold or is too large, which in a geared type of press results in stripped gears, etc. A number of these machines have been installed in locomotive building plants; the usual capacity is 100 tons, arranged so that either 40, 60 or 100 tons may be used, depending on the size of the work. This results in a saving of power. A large pullback provides a quick return stroke and ample power for stripping the dies. The field for such a press in a locomotive or car shop is large, and it is claimed for this machine that it will accomplish such work at minimum cost.

This press is manufactured by the Chambersburg Engineering Company, Chambersburg, Pa.



Hydraulic Press for Heavy Forging and Bending.

MILL FOR GRINDING LIME.—The latest agricultural enterprise reported by a railroad is that of the New York, New Haven & Hartford in establishing a mill, at West Stockbridge, Mass., to grind lime for the benefit of the farmers of western Massachusetts and Connecticut. Representatives of the industrial bureau maintained by the road, learning that one of the principal needs of the soil in New England was lime, cast about for a supply of that article; and they found that the extensive deposit near West Stockbridge was of a suitable character.

NEWS DEPARTMENT

The Southern Railway has made a general increase in the pay of shop men.

The Union Pacific is now a double track road from Omaha, Neb., to Cheyenne, Wyo., 516 miles. This is the longest stretch of double track railroad west of the Missouri River.

The Minneapolis, St. Paul & Sault Ste. Marie has announced a plan for the organization of a co-operative association among employees, to be open to any who have been in the service of the company for six months or longer, under which employees will be allowed to set aside a portion of their earnings to be invested in securities of the company.

Electrical repair shops designed to handle all of the electrical equipment of the New York, New Haven & Hartford are approaching completion at Van Nest, Bronx Borough, New York City, and it is expected they will be in operation by August 1, or a short time before the electrification of the road from Stamford to New Haven is finished. The new shops represent an outlay of about $650,000 and cover two acres of ground. They are made up of an inspection shed, repair shop proper, lye vat house, blacksmith shop, storehouse and power house. The inspection shed has four track pits 375 ft. long. The repair shop proper covers nearly an acre and a half of ground, the power house 3,000 square feet and the storehouse 7,500 square feet.

ILLINOIS CENTRAL EMPLOYEES OFFER AID TO THE COMPANY

Officers of the Illinois Central were greatly surprised recently to receive a communication signed by a large number of clerks, engineers, conductors and other employees requesting that they be permitted to give one or more days' pay to aid the company in making repairs rendered necessary by the recent floods in the south. The employees also sought permission to solicit contributions from all employees on the payroll of the company by means of the following statement: "We feel as railroad employees that we should deeply deplore these unfortunate conditions and to the end that the Illinois Central may have our assistance, co-operation and support in rebuilding and repairing bridges, track and equipment, we hereby appeal to you to join us in the contribution of the equivalent of one or more days' pay to that end." In declining the offer, Vice-president W. L. Park said in part: "In all my railroad experience, in the ranks and as an officer, I never have encountered so unselfish and loyal an offer. That these men should voluntarily tender their mite to assist their company (and I use the word 'their' advisedly, for such men are really partners in the institution) is an evidence of such patriotic loyalty and self-abnegation that I am inclined to the belief that it is unparalleled in railroad history."

DEDICATION OF NEW BUILDINGS AT UNIVERSITY OF ILLINOIS

The new transportation building and the new locomotive and mining laboratories of the engineering department of the University of Illinois were dedicated with appropriate exercises at Urbana, Ill., on May 8, 9 and 10. At the opening session on May 8, J. G. Pangborn, special representative of the president of the Baltimore & Ohio, presented an address outlining the history of the various inventions which led up to the use of steam for propulsion and the development of the various types of the steam locomotive. The program for Friday began with a railway conference in the Transportation building, at which B. A. Worthington, president of the Chicago & Alton, discussed "Modern Problems of the Steam Railway," and W. B. McKinley, president of the Illinois Traction System, "The Modern Problems of the Electric Railway."

Robert Quayle, general superintendent of motive power of the Chicago & North Western, spoke on "How Can the Technical School Help in the Solution of Railway Problems?"

Samuel O. Dunn, editor of the *Railway Age Gazette*, spoke on "Research as a Factor in Railway Administration."

The formal dedicatory exercises were held on Friday afternoon in the university auditorium. Dr. W. F. M. Goss, dean of the College of Engineering, presided and addresses were made by Dr. E. J. James, president of the university; W. L. Abbott, president of the board of trustees; and Willard A. Smith, editor of the *Railway and Engineering Review*. A "Mining Conference" was held on Thursday and Friday.

GERMAN PASSENGER CARS

In a paper on the Administration of the State Railways of Prussia-Hesse, recently delivered before the New York Railroad Club, by W. J. Cunningham, some statistics of passenger cars are given as follows:

Altogether there are 51,703 passenger, baggage and mail cars in Prussia, or 222 per 100 miles of line. In group 2 of the United States the passenger train car density is 52; in the United States as a whole, 20. Of the Prussian equipment 68 per cent. have side entrances and 32 per cent. have end doors and vestibules. The latter are used almost exclusively in through trains. More than half of the passenger cars have three axles, one under each end of the car and one under the center; 33 per cent. have but two axles; and the remaining 13 per cent. are of the modern type for the best trains and have four or six axles. Averaging all passenger train cars, the number of axles per car is 2.72. The older type of two or three axle car with side doors is very small and weighs about 20 tons. The modern corridor car, with four or six axles, is 60 ft. long, 9½ ft. wide, and weighs from 45 to 55 tons. The capacity of the car depends upon the classification of the compartments. There are four classes First-class compartments seat four passengers (two per seat); second-class, six passengers; third-class, eight passengers. Fourth-class compartments are much larger, but only a limited number of seats are provided for the first comers—the other passengers stand. As a rule, those who stand in fourth-class compartments far outnumber the fortunate few with seats. There is little difference between first and second-class compartments except in the quality of the seat covering and in the number of passengers per compartment. The seats are of equal length (about 6 ft.). In first-class compartments, therefore, each passenger has about 3 ft. of seat space. Second-class passengers each have 2 ft. of seat space. In both cases the arm rests, which mark the seat divisions, may be pushed up out of the way, and when the compartment is not filled the seat may be used as a sofa. A party of three or four passengers traveling together very frequently have the compartment to themselves. At important stations seats in through trains may be reserved in advance without charge. Each compartment and seat is numbered and the place ticket issued by the reservation clerk gives unquestioned right to the seat reserved.

A very few of the cars are exclusively first class. About 11 per cent. are first and second-class combined. The same percentage combines second and third-class. Third-class cars comprise 40 per cent. of the total, and 29 per cent are fourth-class. The remaining cars have various combinations of classes.

MEETINGS AND CONVENTIONS

American Railway Tool Foremen's Association.—The annual convention will be held at the Hotel Sherman, Chicago, July 22, 23 and 24, and the prospects are that there will be a record attendance.

International Railway General Foremen's Association.—The annual convention will be held at the Hotel Sherman, Chicago, July 15-18. Reports have been prepared on apprenticeship, shop schedules, engine house efficiency, maintenance of superheater locomotives and driving box work. Indications are that the meeting will be even more largely and enthusiastically attended than that of last year. Application for membership should be made to the secretary, William Hall, 829 W. Broadway, Winona, Minn.

Traveling Engineers' Association.—The twenty-first annual convention will be held at the Hotel Sherman, Chicago, Ill., commencing Tuesday, August 12, 1913, and continuing four days.

The subjects to be discussed are as follows: Uniform instruction to enginemen on the handling of superheater locomotives, J. W. Hardy, chairman. Credit due the operating department for power utilization and train movement that reduces the consumption of fuel per ton mile, M. J. Howley, chairman. The care of locomotive brake equipment on line of road and at terminals, also methods of locating and reporting defects, H. A. Flynn, chairman. The following papers will be read: Advantages obtained with the brick arch in locomotives, LeGrand Parish. What can we do to eliminate the black smoke evil on locomotives? J. H. Lewis. Scientific train loading and tonnage rating; the best methods to obtain maximum tonnage haul for the engine over the entire division, taking into consideration the grades at different points on the division, O. S. Beyer, Jr.

Illuminating Engineering Society.—At a meeting of the convention committee, held in Pittsburgh Friday, May 16, it was decided to hold the next annual convention in that city during the week beginning September 22. The convention committee consists of: C. A. Littlefield, New York Edison Company, chairman; P. S. Millar, Electrical Testing Laboratories, president of the society; H. S. Evans, Macbeth Evans Glass Company, Pittsburgh; W. A. Donkin, contract manager Duquesne Light Company, Pittsburgh, Pa.; D. MacFarlan Moore, General Electric Company, Harrison, N. J.; M. C. Rypinski, Westinghouse Electric & Manufacturing Company, New York; C. J. Mundo, General Electric Company, Pittsburgh; J. C. McQuiston, Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.; W. J. Serrill, United Gas Improvement Company, Philadelphia, Pa.; S. B. Stewart, Philadelphia Company, Pittsburgh, Pa.; T. J. Pace, Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., and Professor H. S. Hower, Carnegie Technical Schools, chairman of the local section of the society. W. A. Donkin of the Duquesne Light Company, was selected as chairman of the local committee on arrangements which will have charge of the convention. J. C. McQuiston of the Westinghouse Electric & Manufacturing Company, was appointed chairman of the publicity committee and will make all arrangements for advertising the convention.

Canadian Railway Club.—A. H. Kendall, foreman of the locomotive erecting shop, Angus shops, Canadian Pacific, presented a paper at the April meeting on the subject of "System as Applied to Shop Repairs of Locomotives." A general description of the system in use at the Angus shops formed the principal part of the paper. A number of charts and reproductions of forms used in connection with this system were included. The general master mechanic's office prepares a monthly statement for the shop, which gives the number of locomotives expected to be shopped from each division during the following month. This includes the general classification of the repairs and also shows in a general way the chief causes for shopping the engine. With this at hand, the ordering of the necessary material and other preparations can be made before the engines actually reach the shop. The system also includes an inspector's or demonstrator's department which takes care of the standardization of the machine operations and methods. The shop works on a straight piece-work basis, the price schedule being detailed, so far as is practicable, so that when more than one operator is called on to work on the same piece, each is paid for the portion that he may do. There is a schedule department which provides each department, each day, with a list of the work required from it for that day. There are standard schedules arranged, copies of which were reproduced in the paper, and every effort is made to adhere strictly to them. A general progress sheet is supplied to the shop superintendent each day which shows where any deviation from the required schedule may have taken place and, in addition, a general operation and delay sheet is furnished, which gives the causes for any delay where it is possible to do so.

New York Railroad Club.—Frederick C. Syze, trainmaster of the Baltimore & Ohio at St. George, Staten Island, N. Y., presented a paper entitled "Thoughts on Discipline" at the May meeting. After briefly reviewing the general features that govern good discipline, Mr. Syze gave a general description of the methods in vogue on the Baltimore & Ohio which were originated by A. W. Thompson, third vice-president. In this system the practice of suspending employees in engine and train service because of infractions of the rules, or for other causes, is discontinued. A complete and accurate record of each employee is maintained and in case of infraction of the rules, after investigation, a suitable entry is made on the employee's record. A central discipline bureau has been organized and the system requires the use of printed forms, one of which is made in triplicate, giving the record of the employee after each new entry. A carbon copy of this is sent to the employee and must be signed by him and returned. W. G. Besler presented a discussion on this subject in which he reviewed the fundamental characteristics of good discipline. J. G. Dickson, division superintendent of the Erie at Jersey City, described the methods of discipline in vogue on that road. All matters that may be the proper cause for punishment are considered at a staff meeting of the division officers who have regularly stated weekly meetings for this purpose. The recommendations of the staff, acting as a discipline committee, are enforced and it is seldom that a case is carried to a higher officer on appeal. F. W. Brazier, superintendent rolling stock, New York Central & Hudson River, recommended the use of complimentary letters or oral communications whenever an occasion arises that justifies it.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

AIR BRAKE ASSOCIATION.—F. M. Nellis, 53 State St., Boston, Mass.

AMERICAN RAILWAY MASTER MECHANICS' ASSOC.—J. W. Taylor, Old Colony building, Chicago. Convention, June 11-13, 1913, Atlantic City, N. J.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—A. R. Davis, Central of Georgia, Macon, Ga. Convention, July 22-24, 1913, Chicago, Ill.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa. Annual convention, June, 1913.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Annual meeting, December 3-6, Engineering Societies' Building, New York. Railroad session, Thursday morning, December 5.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 North Fiftieth Court, Chicago; 2d Monday in month, Chicago.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. G. Hall, 922 McCormick building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 829 W. Broadway, Winona, Minn. Convention, July 15-18, 1913, Chicago, Ill.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, Lima, Ohio. Convention, August 18, 1913. Richmond, Va.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Old Colony building, Chicago. Convention, June 16-18, 1913, Atlantic City, N. J.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOC. OF U. S. AND CANADA.—A P. Dane, B. & M., Reading, Mass. Convention, Sept. 9-12, 1913, Ottawa, Can.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y. Convention, August 12-15, 1913, Hotel Sherman, Chicago, Ill.

PERSONALS

It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.

GENERAL

FRANK B. BARCLAY, master mechanic of the Illinois Central, at McComb, Miss., has been appointed superintendent of motive power of the lines south of the Ohio river, and of the Yazoo & Mississippi Valley, with headquarters at Memphis, Tenn.

ROBERT W. BELL, superintendent of machinery of the Illinois Central at Chicago, has been appointed general superintendent of motive power of the Illinois Central and the Yazoo & Mississippi Valley, succeeding M. K. Barnum, resigned.

MORGAN K. BARNUM, who has resigned as general superintendent of motive power of the Illinois Central and the Yazoo & Mississippi Valley, was born April 6, 1861. He graduated from Syracuse University in 1884 with the degree of A. B. and later received the degree of A. M. He began railway work the year he graduated as a special apprentice in the shops of the New York, Lake Erie & Western, now the Erie, at Susquehanna, Pa. He was then consecutively machinist and mechanical inspector and later general foreman of the same road at Salamanca, N. Y.; general foreman of the Louisville & Nashville shops at New Decatur, Ala.; assistant master mechanic of the Atchison, Topeka & Santa Fe at Argentine, Kan.; superintendent of shops at Cheyenne, Wyo.; district foreman at North Platte, Neb., and then division master mechanic at Omaha, Neb., on the Union Pacific; assistant mechanical superintendent on the Southern Railway. In February, 1903, he was made superintendent of motive power of the Chicago, Rock Island & Pacific, and in April of the next year was made mechanical expert of the Chicago, Burlington & Quincy; in 1907 he was appointed general inspector of machinery and equipment of the same road. He left that road in April, 1910, to become general superintendent of motive power of the Illinois Central and the Yazoo & Mississippi Valley, the position he now leaves.

M. K. Barnum.

J. W. G. BREWER, superintendent of the Mount Clare shops of the Baltimore & Ohio, has been appointed assistant superintendent of motive power of the main line district with headquarters at Baltimore, Md.

H. W. GARDNER has been appointed supervisor of material of the Lake Shore & Michigan Southern, with headquarters at Cleveland, Ohio, succeeding F. H. Hanson, promoted.

GEORGE O. HAMMOND has been appointed assistant mechanical superintendent of the New York, New Haven & Hartford, with headquarters at New Haven, Conn., and the position of assistant to the mechanical superintendent has been abolished.

JOSEPH H. NASH, superintendent of the Burnside shops of the Illinois Central, has been appointed superintendent of motive power of the lines north of the Ohio river, with headquarters at Chicago.

H. C. OVIATT, general inspector of the New York, New Haven & Hartford, has been appointed assistant mechanical superintendent, with office at New Haven, Conn., and his former position has been abolished.

G. W. WILDIN, mechanical superintendent of the New York, New Haven & Hartford, has been placed in charge of the maintenance of electric locomotives and multiple unit cars and the operation and maintenance of power stations, and his jurisdiction has also been extended over the Central New England.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

W. A. BEDELL, master mechanic of the St. Louis, Iron Mountain & Southern at Van Buren, Ark., has been transferred to Jefferson City, Mo.

W. BORBRIDGE, district master mechanic, District No. 2, Eastern division and Montreal terminal of the Canadian Pacific, at Montreal, has been appointed district master mechanic, District No. 5, Eastern division, with headquarters at Smiths Falls, Ont.

J. F. BOWDEN has been appointed master mechanic of the Baltimore & Ohio at Newark, Ohio. Mr. Bowden served his apprenticeship in the Baltimore & Ohio shops at Keyser, W. Va., starting in March, 1885. He became roundhouse foreman at Grafton in September, 1895, and general foreman at Washington, D. C., November 1, 1898. He was then general foreman at Cumberland, Md., and at Benwood, W. Va., and was appointed master mechanic at Parkersburg, W. Va., in September, 1907. He was transferred in the same capacity, December 1, 1908, to Garrett, Ind., and now becomes master mechanic of the same road at Newark, Ohio, as noted above.

J. M. BURKE has been appointed district master mechanic, District No. 4, Eastern division of the Canadian Pacific, with headquarters at Ottawa, Ont.

A. L. CREW, road foreman of engines of the Atchison, Topeka & Santa Fe, at San Bernardino, Cal., has been transferred to Los Angeles, Cal.

JAMES A. CULLOM has been appointed general road foreman of engines of the Atchison, Topeka & Santa Fe, at Shopton, Ia.

W. A. CURLEY, master mechanic of the Missouri Pacific at McGehee, Ark., has been transferred to Van Buren, Ark., succeeding W. A. Bedell, transferred.

WILLIAM H. DYER has been appointed master mechanic of the Georgia & Florida, with headquarters at Douglas, Ga., succeeding E. C. Hanse, assigned to other duties.

H. F. GREWE, general foreman of the mechanical department of the Wabash-Pittsburgh Terminal and the West Side Belt, at Carnegie, Pa., has been appointed master mechanic in charge of locomotive and car departments of both companies, with headquarters at Rook (Carnegie, Pa.).

JOSEPH MCCABE has been appointed master mechanic of the Shore Line division of the New York, New Haven & Hartford, with headquarters at Harlem River, N. Y. Mr. McCabe was born on December 6, 1863, at New Rochelle, N. Y., and was educated in the public schools of his native town. He began railway work on August 11, 1881, with the New York, New Haven & Hartford and in 1885 was appointed fireman and later was made engineman. In December, 1902, he was promoted to road foreman of engines, and in January, 1907, was made master mechanic, and then general road foreman of engines later in the year. In April, 1912, he was appointed master mechanic of the Western division, and now becomes master mechanic of the Shore Line division of the same road, as above noted.

F. W. NELSON, road foreman of engines, Western division, New York, New Haven & Hartford, has been appointed general road foreman of engines with office at New Haven, Conn., succeeding C. H. Reid, promoted.

C. H. REID, general road foreman of engines of the New York, New Haven & Hartford, has been appointed master mechanic of the Western division, with office at Waterbury, Conn., succeeding Joseph McCabe, transferred.

F. W. RHUARK has been appointed master mechanic of the Baltimore & Ohio, at Garrett, Ind. Mr. Rhuark began railway work as a water boy with the Baltimore & Ohio in June, 1879. He was then a machinist with the Lake Shore, the Toledo & Ohio Central and the Chicago & Alton railroads. In 1893 he became road foreman of engines of the Baltimore & Ohio, and was later in the service of the Big Four, the Erie and the St. Louis & San Francisco railroads. He was appointed machine shop foreman of the Baltimore & Ohio in January, 1906, and then was successively general foreman and motive power inspector until December 1, 1910, when he was appointed master mechanic at Lorain, Ohio, the position he now leaves.

WILLIAM J. RIDLEY has been appointed road foreman of engines of the Fargo division of the Northern Pacific at Fargo, N. D.

T. R. STEWART has been appointed master mechanic of the Baltimore & Ohio, at Cumberland, Md. Mr. Stewart began railway work with the Baltimore & Ohio in September, 1886. He was consecutively boilermaker, foreman, roundhouse foreman and general foreman until February, 1904, when he was appointed master mechanic, and is now transferred in the same capacity from the Riverside shops, Baltimore, Md., to Cumberland, as above noted.

WILLIAM S. TASKER, master mechanic of the Rock Island Southern at Rock Island, Ill., has had his jurisdiction extended over the entire road.

T. M. VICKERS, formerly master mechanic of the San Pedro, Los Angeles & Salt Lake, has been appointed general foreman of the Oregon Short Line at Pocatello, Ida.

J. M. WHALEN has been appointed master mechanic of the St. Louis, Iron Mountain & Southern, at McGehee, Ark., succeeding W. A. Curley, transferred.

CAR DEPARTMENT

W. J. HALLETT, car foreman of the Grand Trunk at Allandale, Ont., has been appointed traveling car inspector of the Ontario lines and districts Nos. 8, 9 and 10 of the Eastern lines, with headquarters at London, Ont.

F. H. HANSON has been appointed assistant master car builder of the Lake Shore division of the Lake Shore & Michigan Southern, with headquarters at the Collinwood shops, Ohio.

J. S. JACKSON, general car foreman of the Canadian Northern Quebec at Joliette, Que., has been appointed foreman of the new passenger car shops at Limoilou Jct., Que.

T. MARTIN, foreman of the repair yard of the Canadian Pacific, at Winnipeg, has been appointed foreman of the freight car shop, succeeding H. N. Osborne, transferred.

H. N. OSBORNE, foreman of the freight car shop of the Canadian Pacific, at Winnipeg, has been appointed general car foreman of the Ogden shops, Calgary, Alta.

S. J. PIGGOTT, assistant foreman of the car repair yard of the Canadian Pacific, at Winnipeg, has been appointed foreman, succeeding T. Martin, promoted.

R. STANLEY has been appointed car foreman of the Grand Trunk, at Allandale, Ont., succeeding W. J. Hallett, promoted.

H. J. WHITE, general car and wrecking foreman of the Canadian Pacific, at West Toronto, Ont., has been appointed general car foreman of the Canadian Northern Quebec, at Joliette, Que., succeeding J. S. Jackson.

P. ALQUIST has been appointed superintendent of the car department of the Missouri, Kansas & Texas, with office at Sedalia, Mo. Mr. Alquist was born in Stockholm, Sweden, in 1874, and came to this country in 1885, settling at Memphis, Tenn. He started his railroad career as car repairer for the Illinois Central at Memphis in the early part of 1895, working for the same road as car interchange inspector, repair track foreman, assistant general foreman, and general foreman of the car department of the Memphis, Mississippi and Fulton divisions until 1910, when he left to go with the Cincinnati, Hamilton & Dayton as general foreman of the car department at Lima, Ohio. He left that road after about eighteen months' service to go to the Pere Marquette as general car foreman at Grand Rapids, Mich., and was subsequently general inspector and chief inspector of the car department until his recent appointment as superintendent of car department of the Missouri, Kansas & Texas, succeeding W. A. Mitchell, who was master car builder. The office of master car builder has been abolished.

P. Alquist.

SHOP AND ENGINE HOUSE

MATTHEW AMEY has been appointed assistant night roundhouse foreman of the Chicago & North Western at East Clinton, Ill., succeeding M. J. DeLacey, promoted.

P. CONIFF has been appointed superintendent of shops of the Baltimore & Ohio, at Mount Clare, Baltimore, Md. Mr. Coniff began railroad work in 1888. He was a machinist on the Pittsburgh & Lake Erie, the Pittsburgh, Fort Wayne & Chicago and the St. Louis, Iron Mountain & Southern railroads until December, 1902, when he entered the service of the Baltimore & Ohio as a roundhouse foreman. He later became general shop foreman, and was promoted to master mechanic at Cumberland, Md., on May 1, 1911, which position he held at the time of his recent appointment as superintendent of shops. He succeeds J. W. G. Brewer, who has been appointed assistant district superintendent of motive power of the main line district, with headquarters at Baltimore.

P. Coniff.

CHARLES BOERTMAN has been appointed superintendent of shops of the Pere Marquette at Saginaw, Mich., in place of George Hilfrink.

C. C. Colley has been appointed purchasing agent of the Louisiana Railway & Navigation Company, with headquarters at Shreveport, La., succeeding G. E. Smith, resigned.

J. L. Crouse has been appointed superintendent of shops, electric division, New York, New Haven & Hartford, at Van Nest, N. Y.

J. Kirkpatrick has been appointed master mechanic of the Baltimore & Ohio, at the Riverside shops, Baltimore, Md. Mr. Kirkpatrick served his machinist apprenticeship with the Kingston (Ontario) Locomotive Works from 1878 to 1882, and was later connected with the Canadian Pacific, the South Eastern and the Grand Trunk railways. He entered the service of the Baltimore & Ohio in March, 1903, and was promoted to master mechanic in the New Castle, Pa., shops in August, 1903, remaining in that position until 1905, when he was transferred to Cumberland in the same capacity. In February, 1907, he went to the Newark, Ohio, shops as master mechanic, and now goes to the Riverside shops of the same road as master mechanic, as noted above.

J. Kirkpatrick.

H. E. Myers has been appointed shop superintendent of the Lehigh Valley at Packerton, Pa. Mr. Myers was born March 12, 1880, at St. Joseph, Mo., and was educated in the public schools. He entered railroad service in 1897 on the Kansas City, St. Joseph & Council Bluffs, now a part of the Burlington system. After serving the regular machinist's apprenticeship he was employed as a machinist for the Burlington at La Crosse, Wis., for two years, going from there to the Hannibal & St. Joseph at Hannibal, Mo., in the same capacity. On February 17, 1903, he entered the service of the Union Pacific at Omaha, Neb., as piece-work inspector in the locomotive shops and was later gang foreman and assistant to the general foreman. On August 1, 1905, he entered the service of the Atchison, Topeka & Santa Fe at Fort Madison, Ia., as general machine foreman, leaving December 1, 1906, to go to the Lehigh Valley as shop inspector at Sayre, Pa. In October, 1912, he was promoted to the position of assistant master mechanic of the New York, New Jersey and Lehigh division of the same road, which position he held at the time of his recent appointment as superintendent of shops at Packerton, Pa., as noted above.

H. E. Myers.

H. Darling has been appointed acting locomotive foreman at Nicholl, B. C., succeeding J. Lambie, assigned to other duties.

Martin J. De Lacey, assistant roundhouse foreman of the Chicago & North Western, has been promoted to the position of night roundhouse foreman at East Clinton, Ill., succeeding F. G. Clark, resigned.

P. J. Donohue has been appointed foreman boilermaker of the Chicago, Rock Island & Pacific, at Biddle, Ark.

F. C. Hamilton has been appointed general foreman of the mechanical department of the Atchison, Topeka & Santa Fe, at Argentine, Kan.

H. Hitchens, erecting shop foreman of the Atchison, Topeka & Santa Fe, at Albuquerque, has been appointed general roundhouse foreman, with headquarters at Winslow, Ariz.

E. J. McMahon has been appointed machine foreman of the Houston & Texas Central at Ennis, Tex.

J. P. Moore has been appointed assistant roundhouse foreman of the St. Louis & San Francisco, at Monett, Mo.

W. J. Paul, roundhouse foreman of the Chesapeake & Ohio at Hinton, W. Va., has been appointed erecting shop foreman of the Atchison, Topeka & Santa Fe, at Albuquerque, N. M., succeeding H. Hitchens, promoted.

H. L. Turton has been appointed general foreman of the Houston & Texas Central at Ennis, Tex.

NEW SHOPS

Canadian Pacific.—An officer writes that the company is building large extensions to the Angus shops, Montreal, Que., including the following: steel passenger and freight car shops, locomotive shop extension, new bolt and nut shop, power house extension, upholstering shop extension, general office building extension, pattern storage building extension, and maintenance building. The cost of the improvements will be about $500,000.

Chicago & Alton.—This company has appropriated $987,000 for the erection of new shops at Bloomington, Ill. This is in connection with an extensive program of improvements at Bloomington, a part of which has already been completed.

Minneapolis, St. Paul & Sault Ste. Marie.—It is announced that the roundhouse at Duluth, Minn., is to be enlarged from a 12-stall to a 20-stall structure.

New York, New Haven & Hartford.—The repair shops at Van Nest, N. Y., for electrical equipment, are nearing completion, and it is expected will be in operation by August 1.

Philadelphia & Reading.—This company has given contracts to Irwin & Leighton, Philadelphia, for two new car repair shops to be built at St. Clair, Pa. The buildings are to be one story, and will be 45 ft. high. One will be 83 ft. 10 in. wide x 604 ft. 8 in. long, and the other 53 ft. 9 in. wide x 464 ft. 8 in. long. They will be of steel, concrete and brick construction, with steel sashes. Work was started on the improvements on May 13.

Change of Gage in Australia.—A report from Melbourne states that a conference of the chief engineers of the Commonwealth and State railway departments has urged the immediate adoption of a uniform 4 ft. 8½ in. gage throughout Australia. —*The Engineer.*

Copper in Rails.—The Chicago, Milwaukee & St. Paul is having 10,000 tons of rails rolled containing .5 per cent. copper. This follows an order of 5,000 tons of the same composition rolled last year, which went through the past winter without a single broken rail.

SUPPLY TRADE NOTES

Charles R. Westcott has been elected secretary and treasurer of the M-C-B Company, Chicago.

The Railway Utility Company has removed its office from the Monadnock building to 226 South LaSalle street, Chicago.

The Standard Coupler Company, 2 Rector street, New York, has moved its general offices to 30 Church street, New York.

The Pilliod Company, New York, has moved its offices from room 1823, 30 Church street, to room 829 in the same building, where larger floor space has been secured.

The offices of Burton W. Mudge & Co. have been moved from the Peoples Gas building to the Railway Exchange, Chicago, and the firm name has been changed to Mudge & Company.

The Baldwin Locomotive Works is preparing to begin construction on the first unit of its new plant at East Chicago, Ind., for which approximately 370 acres of land was purchased last year.

George D. Rosenthal, manager of the St. Louis, Mo., office of the General Electric Company, Schenectady, N. Y., died in New York on May 19. Mr. Rosenthal had been with the company for over 20 years.

The Hon. William C. Redfield, having been appointed a member of President Wilson's cabinet, has resigned as vice-president and a member of the board of directors of the American Blower Company, Detroit.

George W. Craven, manager of the Chicago office of the C. & C. Electric Company, New York, has been made manager of the welding department of that company, with headquarters at Garwood, N. J., succeeding George A. Hills, resigned.

W. P. Hawley has been elected vice-president of the United States Light & Heating Company, New York. Mr. Hawley was born in Chatham, N. Y., August 1, 1883. He received a high school education at that place, and after graduation worked in the state bank for five years. In September, 1904, he left Chatham and came to New York. He entered the service of the Manhattan Lighterage Transportation Company, which was sold to the Central Railroad of New Jersey on January 1, 1905. On that date Mr. Hawley took a position with the United States Light & Heating Company of New Jersey. Upon the consolidation of the United States Light & Heating Company of New Jersey, the Bliss Car Lighting Company, Milwaukee, Wis., and the National Battery Company, Buffalo, N. Y., under the name of the United States Light & Heating Company, of Maine, Mr. Hawley was made manager of the New York office, which position he still holds in addition to his duties as vice-president.

W. P. Hawley.

The Buda Company, Chicago, Ill., has announced the establishment of a headlight department for the manufacture and sale of the Buda-Ross electric headlight. Mark A. Ross will be in charge of the department, and Harry P. Bayley and John Eberhart will be associated with him.

G. E. Stoy has resigned as general foreman of the Trinity & Brazos Valley at Galveston, Tex., to take charge of the locomotive department of the Vandaveer Clay Products Company, Houston, Tex. He will have charge of all installations of their patent locomotive firebox liners and oil burners.

J. W. Cleary, one of the oldest electric headlight men in the country, who joined the forces of the National Electric Headlight Company in Indianapolis in 1891, and in 1899 became associated with the Pyle-National Electric Headlight Company, Chicago, as traveling engineer, has resigned his position and will go abroad for several months.

W. S. Murray has resigned as electrical engineer of the New York, New Haven & Hartford, and has formed a partnership with E. H. McHenry, who recently resigned as vice-president of the New Haven, under the firm name of McHenry & Murray, engineers. The firm will specialize in railway electrification work, including plans, estimates, construction and operation, and will handle work of this character for the New Haven.

The Forsyth Brothers Company, Chicago, has transferred all right and title in the Forsyth draft gear, buffing device, radial device, truck actuating device and yoke, and the Chaffee centering device to the Waugh Draft Gear Company, Chicago, and all future negotiations and correspondence relating to these devices should be carried on with Wendel & MacDuffie Company, general sales agents, 165 Broadway, New York.

BLOCK SIGNALS IN THE UNITED STATES.—The length of road operated under the automatic block system January 1, 1913, was 22,218.8 miles, and under the manual system 61,751 miles, a total of 83,949.8 miles.

BRAZILIAN RAILWAY.—The President of Brazil has signed a decree approving definite plans and estimates amounting to $1,100,000 for the railway line between kilometer 0 and 105 of the Coroata to Tocatins Railway.

NEW LINE FOR NORWAY.—A short railway is to be constructed connecting Aalgaard with the present Stavanger-Egersund Railroad. It will be the first branch line to penetrate the mountainous region, although requiring no difficult engineering feat, for its roadbed will lie in one of the valleys. According to the estimates announced on April 9 by the engineer who has made the preliminary survey, the line will be 8¼ miles in length, have a maximum grade of 2 per cent., and will cost approximately $275,000.

COMPARISON BETWEEN RAILROAD STOCK AND REAL ESTATE.—A man who bought 100 shares of Pennsylvania Railroad stock 50 years ago—say the first day of the battle of Gettysburg—paid approximately $6,000 for it. If he kept it until today he would have received about 6 per cent. on his money all that time, but his capital would now be only $5,600.

Had a man on the same day bought a piece of real estate for $6,000 in the central part of Philadelphia or in any direction around it or in almost any other thriving town, the increase in his capital now would be very great, in almost every case. One man who 24 years ago paid $30,000 for a Chestnut street property recently refused $460,000 for it. His capital has multiplied by more than 15.

It is a curious thing that there is such a general impression that those who own railroads have grown rich with amazing rapidity. The truth is that a dollar invested half a century ago in America's largest railroad and the one where traffic is densest and the people richest, and where business has grown the fastest, is worth a little less than a dollar today. Similar comparisons might be made with the other standard lines of the East.—*Philadelphia Public Ledger.*

CATALOGS

Vertical Water Tube Boilers.—A series of leaflets is being sent out by the Wickes Boiler Company, Saginaw, Mich., which covers the important features of the design of its boilers.

Steam Turbine Driven Generators.—Bulletin 152 from Crocker-Wheeler Company, Ampere, N. J., is devoted to a description and discussion of the steam turbine driven generators for both alternating and direct current manufactured by that company.

Lamps for Car Lighting.—The advantages of the Edison Mazda lamp for car lighting are fully set forth in a 14-page catalog issued by the General Electric Company, Schenectady, N. Y. Illustrations showing the interior of artificially lighted cars, demonstrating the advantages of this type of light, are freely used.

Blacksmithing and Drop Forging.—Bulletin 2 of a series published by Tate-Jones and Company, Pittsburgh, Pa., is devoted to the subject of heavy forging. Its twenty-four pages include a brief and concise technical discussion of the subject It is well illustrated throughout. The first bulletin of this series was on the subject of welding.

Thermo-Electric Pyrometers.—A comprehensive discussion of the theory, design and construction of thermo-electric pyrometers is included in Bulletin No. 3 from the Hoskins Manufacturing Company, 453 Lawton avenue, Detroit, Mich. It contains 47 pages devoted entirely to this subject and illustrates the Hoskins pyrometer in several forms, both portable and stationary.

Boyer Speed Recorder.—Catalog 42 of the Chicago Pneumatic Tool Company, Fisher building, Chicago, gives an illustrated description, together with instructions for applying and operating the Boyer railway speed recorder. Several pages of the catalog are devoted to a list, with prices, of the supply parts. The illustration shows the recommended method of applying the recorder to both cars and locomotives.

Traverse Shapers.—The Cincinnati Shaper Company, Cincinnati, Ohio, is issuing a new catalog of traverse shapers and crank planers. The former are shown in three strokes—18 in., 22 in. and 26 in.—with one or two heads and in lengths of bed from 8 ft. to 20 ft. The crank planers are shown in two sizes; the catalog also includes some descriptive matter of other types of shapers manufactured by this company.

Rolled Steel Wheels.—The Standard Steel Works Company, Philadelphia, Pa., has issued a new catalog on rolled steel wheels. An interesting feature is the application of a number to each wheel, covering all standard dimensions except the bore. The process of manufacture is fully described and illustrated, and the standard sized axles for steam and electric service are also shown. The book should be of great assistance in the purchasing of wheels.

Text Book on Corrosion.—The Stark Rolling Mill Company, Canton, Ohio, producers of Toncan metal, have prepared a 70-page catalog which is divided into three parts. Part one includes interesting technical information in connection with the corrosion of metals. Part two is devoted to illustrations and a discussion of the advantages of Toncan metal as a corrosion and rust resisting material, and part 3 lists the sheets and other forms of this material that are available, giving the prices of each.

Electric Car Lighting.—Details showing the design and construction of the important features of the axle driven generator system of car lighting manufactured by the Safety Car Heating and Lighting Company, New York, are given in a pamphlet recently issued. It discusses the construction of the commutator on the generator, the generator suspension, the pole changing devices, the bearings of the generator, as well as the dynamo regulator and lamp regulator. Line and photographic illustrations are freely used.

Noiseless Gear Driving.—A 56-page booklet from the New Process Gear Corporation, Syracuse, N. Y., contains engineering arguments in connection with the use of raw hide gears, showing that they are of important economic value where high speed gears are required. The catalog contains much interesting and valuable data on gear transmission and is illustrated with photographs of actual installations. Eleven types of raw hide gears are shown in section and over two thousand sizes of pinions are given in a table that includes the prices.

Gas Welding and Cutting Apparatus.—Oxy-acetylene welding and cutting apparatus in several sizes and types is fully illustrated and described in a catalog being issued by the Davis-Bournonville Company, 90 West street, New York. In addition to the gas producing equipment, the catalog also shows various types of welding torches and includes a number of illustrations of machine welding and cutting devices that have been recently developed by this company. Both oxygen and acetylene pressure regulators are illustrated and other accessories and supplies are listed.

Automatic Air Dump Cars.—Four excellent photographs showing the operation of automatic air dump cars, are included in a recent folder sent out by Kilbourne & Jacobs, Columbus, Ohio. With this type of car the entire train is unloaded from one point and it requires but 15 seconds for dumping and less than 30 seconds for the whole operation of unloading the train and having it ready to start. These cars have an elevated body, supported on steel trunnions mounted on the center sills of the independent underframe. In dumping, the side toward which the load is to be discharged automatically lifts as the hopper is inclined.

Metal Window Sash and Frame.—Catalog No. 7 from David Lupton's Sons Company, Allegheny avenue and Janney street, Philadelphia, includes a complete description of the design of steel window sash and frames and window operating devices, as well as steel louvres, skylights, etc., manufactured by this company. The principle of design of this frame and sash is based on the use of large solid sections made of the least practicable number of pieces welded together by the oxy-acetylene process. The catalog covers various types of steel sash for side walls, steel partitions and doors, the Pond continuous sash and operating device, the Pond truss, rolled steel skylights, hollow metal windows and Waldmire louvres. The illustrations show installations in railroad shops, roundhouses and other buildings, as well as in commercial structures.

Postal Car Lighting.—The specifications issued by the United States Post Office Department governing the lighting of postal cars are explicit in the matter of illumination values to be obtained in different parts of the car, but leave to the discretion of the railways the means to be used in providing the light. A pamphlet prepared by the Safety Car Heating and Lighting Company, 2 Rector street, New York, gives a clear understanding of the requirements of the specifications and suggestions as to suitable means for satisfying them. It interprets the specifications and gives the recommendations of this company regarding the best spacing of the lighting units, the most efficient lamps and reflectors to be used, and the various essentials of suitable and economical lighting of postal cars. This company was actively engaged in the tests from which the government obtained its knowledge of what was required to satisfactorily illuminate postal cars and furnished lighting fixtures and engineers to assist in the conducting of the tests. The information given in the pamphlet is, therefore, reliable and the result of first hand knowledge. A complete copy of the specifications revised to December 28, 1912, is included and diagrams are shown for various arrangements of full and half postal cars with the location of the various types of lighting units shown in red. These diagrams are fully dimensioned. Both gas and electric fixtures are considered.